Integrated Water Quality Management: a mindset change

Testing a refined conceptual model

Report to the
Water Research Commission

by

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OVERVIEW

In 2007 the Water Research Commission initiated a project on integrated water quality management; the aim of the project being to develop a conceptual model for aligning the management of the quality of water resources with that of drinking water quality in order to support the effective management of water use in the interest of all water users (Boyd, Tompkins and Heath, 2010).

The Integrated Water Quality Management (IWQM) approach that has been developed "breaks down" water management into smaller management units while establishing both a horizontal and vertical reporting framework. A further benefit of the model is that responsibility for water quality is based on significantly smaller geographical areas, and accountability to the adjoining areas (horizontal accountability) and to the next level of management (vertical accountability) is established with the establishment of the management unit. This allows accountability for water quality to be focussed on smaller management units, rather than diffused up ever higher levels of management. In other words, by making all water users aware of their own responsibility to the protection of South Africa's water resources and accountable for the impacts that they have on the resource.

It is this mutual understanding between water users of the impacts of their own uses which is aimed at bringing to life the "Everyone is downstream" and "Every water user is a water manager" philosophy. This phase of the project deals with the implementation of the IWQM model approach and describes various changes that have been made to the model as a result of the implementation.

Objectives of the project

The aims of this implementation phase of the project were to:

- Streamline and refine the conceptual model through the implementation of case studies at each management boundary;
- Link the model with relevant tools that must be used for implementation in the management boundaries; and
- Develop an implementation framework for future use of the model.

Ultimately the objective of this project is to "populate" the elements of the business process for management units at different levels of the management framework (using the Upper Breede Catchment as a test case) and assess its viability for broader implementation.

Recapping the conceptual framework

In developing the IWQM model, three main components were identified:

- *Defining principles* which are defined as being generalizations that are accepted as true and that can be used as a basis for reasoning or conduct, such as water being properly valued (e.g. because there is not enough water);
- *Background conditions* which are defined as those conditions external to water quality which support the implementation of this framework and therefore indirectly impact on water quality, such as management systems and tools; and
- *Management units* which are defined as a geographical area that could be managed as a unit owing to common water use characteristics at the "lower" levels and to institutional responsibilities with regard to the management of water quality at the "higher" levels.

The ultimate goal of IWQM is to achieve specific objectives at a particular management unit taking into consideration the defining principles and background conditions relevant to that specific management unit. This can be done using various tools that may include, for example, a Water Safety Plan (WaSP) for a municipality or an Integrated Water and Waste Management Plan (IWWMP) for an industry. However, there are specific elements that must be included in each of the tools:

- Identification of elements of the water use cycle;
- Hazard assessment or risk analysis in which critical risk factors, critical control points and performance targets are set;
- Risk management; and
- Contingency planning.

In view of the above, the business process proposed for the IWQM conceptual model is generic in the sense that its various elements apply at every level of management, or rather to every management unit, and therefore each aspect must be in place in each management unit. However, the details of each element will vary according to the nature of the management unit in question.

The basic premise is to break down the challenge of IWQM into manageable areas in order to reduce the reporting between management units to a simple “Yes” (quality and quantity parameters are being met) or “No” (they are not). This approach demands effective auditing processes but it is structured in such a way that management units next to each other can audit each other. Each management unit is therefore responsible for auditing the quality of the water entering its geographical area and then reporting on that to the next level of management as well as the management unit where the water came from.

Refining the model

Practical experience gained from the piloting and implementation of the model in the Breede River catchment area as well as valuable knowledge gained through discussions at World Water Week in Stockholm (2010) have been used to improve the model. This has fine-tuned the model described in detail in (WRC TT 450/10, 2010).

The water use cycle

The water use cycle is the context for the IWQM framework in the sense that the elements of the water use cycle are those that need to be managed. The water use cycle continues to evolve and it was recognized that precipitation as a consumptive use should also be taken into account.

Amendments to critical control point description

The initial model describes the process in which the hazard and risk assessment will determine critical controls points (CCPs) which are central to the implementation of the business process in every management unit established. However, during the site visits and the one-on-one meetings it was agreed that the critical control points could be at various levels of priority. Therefore the concept of critical risk factors (CRF) was brought in and the business process changed accordingly.

Stakeholder participation

In line with the active stakeholder participation undertaken in the first phase of the project, the second phase included workshops, one-on-one sessions and the development of a background information document for the stakeholders involved in the testing of the model.

A stakeholder database was developed using Access and can be updated as new management units become involved.

Capacity development

As part of the capacity building for the project the following were undertaken:

- Mr Oliver Malete, a project team member, obtained a bursary through Golder Associates Africa and registered and started his Honours degree in Applied Science. This may lead to an MSc in 2011 at the University of Pretoria.
- Ms Dee Padayachee, a project team member, registered with the University of South Africa and started a BSc Honours degree in Environmental Management. Core subjects included impact mitigation, integrated environmental management and environmental systems. The programme runs over two years and is scheduled for completion at the end of 2011.
- Several workshops and working sessions were held with stakeholders from the area.

Conference presentation and proceedings

The project was presented at several conferences and an article accepted for publication in an internal water resources journal:

- WISA 2010 Durban presentation entitled: Implementation of a conceptual model for integrated water quality management in South Africa, L Boyd, R Tompkins, O Malete and D Padayachee. This paper was presented by Oliver Malete and Dee Padayachee.
- WISA 2010 workshop: Integrated water quality management: A new mindset, facilitated by R Tompkins and L Boyd.
- Stockholm Water Week (5-11 September 2010) presentation entitled: An integrated water quality management framework for South Africa: A new mindset.
- Boyd L and Tompkins R (2011). A New Mindset for Integrated Water Quality Management for South Africa. International Journal of Water Resources Development, 27: 1, 203-218.
- Presentation at the Young Water Professionals Conference in April 2011 entitled: Implementation of an Integrated Water Quality Management (IWQM) Model – A South African Context. This will be presented by Oliver Malete and Dee Padayachee.

Challenges

Some challenges experienced during the testing of the model are detailed below.

- Establishment of the CMA was very new and several people from both DWA and the municipality moved to BOCMA; so that while the passion to implement the project was there, the changes occurring internally hindered the process somewhat as the project team struggled to maintain communication with stakeholders;
- It was recognized that stakeholder management is an unrecognized skill; it needs to be done properly and by a skilled practitioner with experience in those processes, not as an add-on to the technical team's tasks; and
- When considering the 'bigger picture' of various levels of management units, the question of who will manage the data exists.

Conclusions

The IWQM management approach breaks down water management into smaller management units while establishing both a horizontal and vertical reporting framework. A further benefit of the model is that responsibility for water quality is based on significantly smaller geographical areas, and accountability to the adjoining areas (horizontal accountability) and to the next level of management (vertical accountability) is established when the management unit is established. This allows accountability for water quality to be focussed on smaller management units, rather than

diffused up ever higher levels of management. In other words, this makes all water users aware of their own responsibility to the protection of South Africa's water resources and accountable for the impacts that they have on the resource.

Based on the identification of CRFs and CCPs in various management unit types, we conclude that the business process is scalable at the various levels of the management framework and across different types of management units in the "Community" level of the management framework. The complexity of the process rests in the details rather than the process itself, and therefore larger management units would necessarily have more CRFs and (possibly) CCPs and different types of management units would have varying degrees of technical expertise required for measurement of their CCPs.

Finally, the IWQM approach allows water quality information to be packaged for a broader audience because reporting is simplified to provide information on whether or not a management unit is within specifications of its CCPs; rather than extensive technical reports to national level through the management chain. This addresses the issue of raising of awareness in the broader community of the basic premise that good water quality is in everyone's best interests while providing for "everyone's" involvement in its management through the allocation of responsibility at more localised levels.

Recommendations

Based on the results of this second phase, it is recommended that a third phase be undertaken to maintain the momentum of the model implementation. As part of such a third phase the following recommendations are made.

It is recommended that a stakeholder engagement team is added to the project team in order to improve the approach to the implementation of a collaborative management mechanism. The project team should be augmented with specialists in stakeholder participation processes who are directed specifically to that task in order to maintain the links with stakeholders. Simultaneously, the technical team will continue its interactive process of workshops to establish Management Units and determine CCPs and CRFs.

To maintain the momentum of the model implementation it is recommended that it is presented more widely at for example, catchment management forum meetings. These meetings are usually constituted of representatives from the various levels that could potentially be management units, including national government.

The implementation of the model will be greatly enhanced if it is converted into a web-based system into which the various management units can report. It is understood that not all management units will have access to the technology required to enter data into such a system and receive reports from it. However, the upper levels of management certainly will. A system for collecting data from those without access to technology (e.g.. a management oriented monitoring system or MOMS) should be integrated into the implementation process of the model. Adequate feedback loops must also be created to ensure that reports reach all management units even if they are not operating a web-based system.

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The Reference Group responsible for this project consisted of the following persons:

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Mr N Rossouw	Aurecon
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LIST OF ABBREVIATIONS

BID	Background information document
BOCMA	Breede-Overberg Catchment Management Agency
BP	Business Process
CCP	Critical Control Point
CMA	Catchment Management Agency
CMF	Catchment Management Forum
CRF	Critical Risk Factor
DWA	Department of Water Affairs
HVWUA	Hex Valley Water User association
IWQM	Integrated Water Quality Management
IWRM	Integrated Water Resources Model
IWWMP	Integrated Water and Waste Management Plan
MOMS	Management oriented monitoring system or MOMS
MU	Management Unit
RWQO	Resource Water Quality Objectives
WaSP	Water Safety Plan
WHO	World Health Organization
WMA	Water Management Area
WRC	Water Research Commission
WSA	Water Services Authority
WUA	Water User Association

GLOSSARY

Background conditions	Those conditions external to water quality which support the implementation of the framework and therefore indirectly impact on water quality
Business process	A process for carrying out a particular activity, in this case, integrated water quality management
Critical Control Point (CCP)	A Critical Control Point (CCP) is defined as a point or process that requires technical target measures or parameter ranges to be met in order to continually assess the hazard potential of the water resource. The CCP is most often defined by regulatory controls. Where, a point includes a discharge point; point in a storm water system; or a point in a water resource[1]; and process may be a procedure or practice such as optimal fertilizer application rate; dam water levels measured or buffer strips in place
Critical Risk Factor (CRF)	A CRF is defined as a point or process at which, if a failure occurs, the CCP performance targets will not be met.
Defining principles	Generalizations that are accepted as true and that can be used as a basis for reasoning or conduct
Hazard potential	The susceptibility of the water resource[1].
ISO 14000	Environmental management system to help organizations to:(a) minimize how their operations negatively affect the environment (i.e. cause adverse changes to air, water, or land); (b) comply with applicable laws, regulations, and other environmentally oriented requirements, and (c) continually improve in the above.
Management unit	A management unit in the context of the IWQM model is a geographical area; not necessarily homogeneous or continuous; that could be managed as a unit owing to common water use characteristics at the “lower” levels and to institutional responsibilities with regard to the management of water quality at the “higher” levels.

[1] As defined in the NWA a water resource includes a watercourse, surface water, estuary, or aquifer; and ``watercourse'' means -

(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette,* declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;

1.0 INTRODUCTION

1.1 Background

In 2007 the Water Research Commission initiated a project on integrated water quality management, the aim of the project being to develop a conceptual model for aligning the management of the quality of water resources with that of drinking water quality in order to support the effective management of water use in the interest of all water users (Boyd, Tompkins and Heath, 2010).

The phase I project encompassed an international literature review as well as a review of the legislative instruments and management processes which relate to water resource and drinking water quality in South Africa; notably the Water Services Act (1997); the National Water Act (1998); the National Water Resources Strategy, Edition 1 (2004); Regulations under section 9(1) of the Water Services Act (1997); a 5-year water resource quality monitoring plan (2004); and a drinking water quality framework for South Africa, Edition 2 (2007).

The literature review showed that some countries have moved towards a catchment-wide approach. However, many strategies, particularly in developing countries, remain focussed on the quality of water at the waterworks and within the distribution system. Evaluated against the integrated catchment-to-consumer cycle used during the project as a context for the management model, the management framework established under current legislation is inadequate as it splits the legislative and institutional frameworks between raw water quality and drinking water quality. Furthermore, it is focussed primarily on monitoring rather than managing water quality. The current management framework in South Africa is therefore reactive, rather than proactive. Furthermore, in developing countries in general; and particularly in South Africa; implementation of national legislation, and enforcement of its provisions, is an acknowledged area of weakness.

Currently, national level systems for the management of water quality are highly complex and positioned at a very high level: nationally (in the case of water resource quality); and at municipal level (in the case of drinking water quality). An added complication is that regulation of drinking water quality takes place at a national level. Accountability for good water quality is therefore also at a high level, at the end of a relatively long management chain.

The conceptual model (Boyd, Tompkins and Heath, 2010) is based on the premise that good water quality is in everyone's best interests. Current management approaches, however, attach responsibility for good water quality at a level that does not identify this premise. The management approach is therefore institutionally based at relatively high levels of government, and does not include potential community structures which should have responsibility for the water that they use both consumptively and non-consumptively. It should be noted that the term "community" is used here in the sense of a group of people or organizsations with common interests; in this case, regarding the quality and quantity of the water within their geographical area.

In essence the IWQM management approach "breaks down" water management into smaller management units while establishing both a horizontal and vertical reporting framework. A further benefit of the model is that responsibility for water quality is based on significantly smaller geographical areas, and accountability to the adjoining areas (horizontal accountability) and to the next level of management (vertical accountability) is established with the establishment of the management unit. This allows accountability for water quality to be focussed on smaller management units, rather than diffused up ever higher levels of management. In other words, by making all water users aware of their own responsibility to the protection of South Africa's water resources and accountable for the impacts that they have on the resource.

It is this mutual understanding between water users of the impacts of their own water use[1] that is aimed at bringing to life the philosophy of *"Everyone is downstream"* and *"Every water user is a water manager"*.

This report sets out the refinements made to the IWQM by testing its' implementation at various management levels.

1.2 Project objectives

The objectives of this testing phase of the project were to:

- Streamline and refine the conceptual model through the implementation of case studies at each management boundary;
- Link the model with relevant tools that must be used for implementation in the management boundaries; and
- Develop an implementation framework for future use of the model.

Ultimately the objective of this project was to "populate" the elements of the business process for management units at different levels of the management framework (using the Upper Breede Catchment as a test case) and assess its viability for broader implementation.

1.3 Methodology and approach

The approach to the development of the conceptual framework for integrated water quality management (IWQM) was to use an interactive forum with relevant stakeholders from both the water supply and sanitation (water services) and water resources sectors throughout South Africa. This interactive process ensured that from project inception, the stakeholders and other interested and affected parties had a good understanding of the project and its progression.

Moreover, this active participation led to a group of stakeholders volunteering to be a test area for the second phase of the project in which the model was refined by seeing how it could be implemented in a small area (the Hex River Valley) of the Breede Catchment area of the Western Cape Province of South Africa.

The testing process has resulted in significant refinement of the original conceptual model and a workable format of the model is now emerging from this process.

The methodology that was followed included:

- Identification of a suitable study area;
- Identification of areas within each management boundary where case studies could be implemented;
- Identification of relevant stakeholders within each management boundary and initiation to the model;
- Workshopping the process to be followed and developing a process flow to be used within each management boundary;
- Developing a stakeholder feedback mechanism including:
    - A stakeholder database which can then be continuously updated as more stakeholders become involved; and
    - Background information documents (BID);

[1] Water use is defined broadly, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation (NWA, 1998).

- Ongoing meetings to discuss progress.

The stakeholder database for the case study area has been drawn up using Access and includes the following features:

- Catchment management forum (CMF) list;
- CMF members;
- Management Unit (MU) types;
- MU names;
- Organizsation list;
- Organization type list;
- Sector list;
- Stakeholder interaction meeting attendance details;
- Stakeholder interaction meeting details;
- Sub-catchment list;
- Water Use Association List; and
- Water User Association members.

This database can be updated as needed and used for other areas as well.

2.0 THE INTEGRATED WATER QUALITY MANAGEMENT MODEL

As described in WRC Report TT450/10 (Boyd, Tompkins and Heath, 2010) the model (*Figure 1*) is comprised of:

- Defining principles;
- Background conditions;
- The Management framework; and
- The generic business process, all briefly described below.

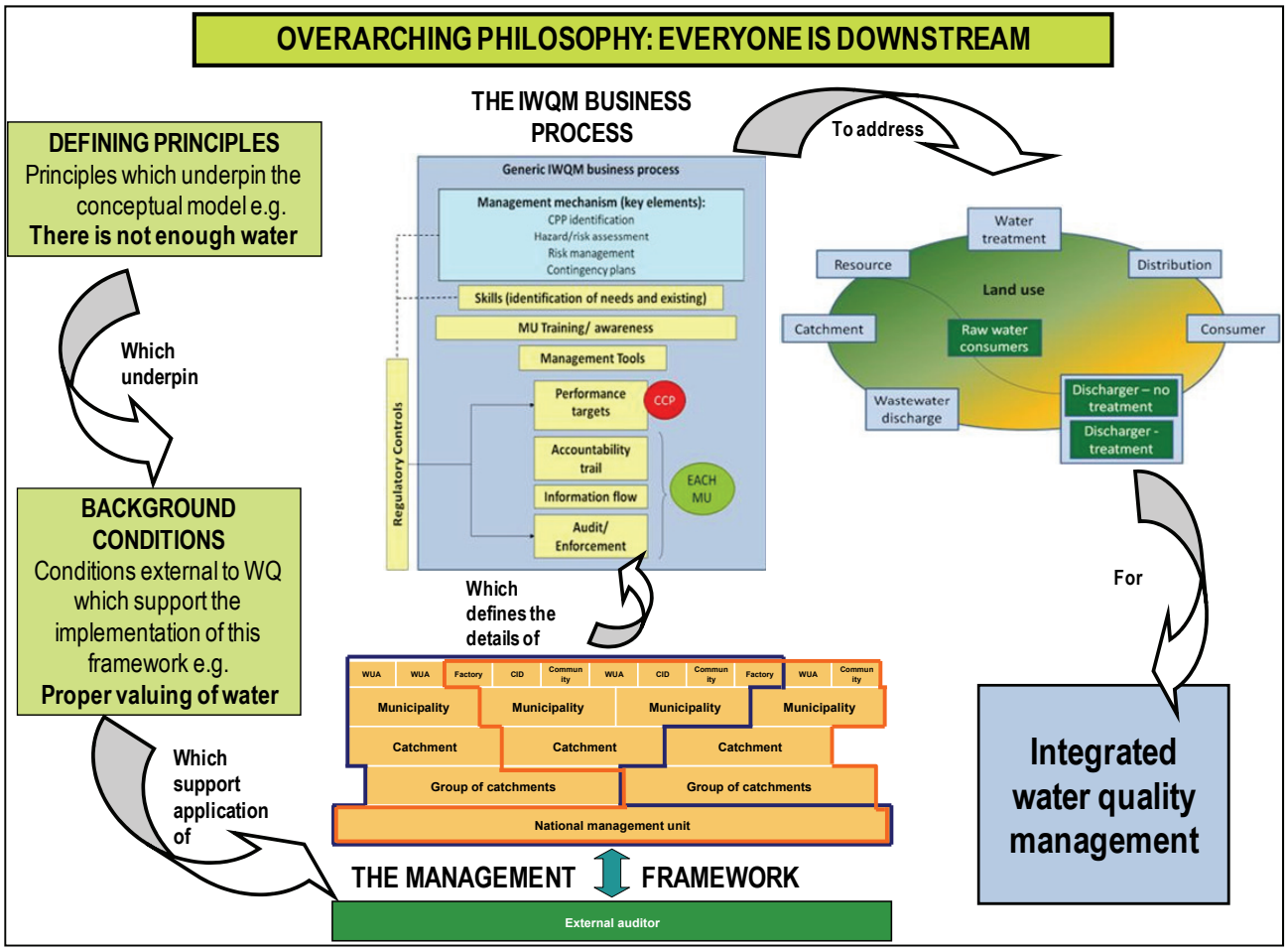


Figure 1: The IWQM Management framework (Boyd, Tompkins and Heath, 2010)

2.1 Defining principles

The following principles were prioritised based on the frequency with which they were raised in the consultation process in the first phase of the project. In this report principles are defined as being generalizations that are accepted as true and that can be used as a basis for reasoning or conduct. These principles therefore underpin the conceptual model for integrated water quality management in the South African context.

Water must be properly valued

It is not only important to ascribe value to water based on water availability and increasing water scarcity. The concept of value in the context of water should include:

- Downstream costs of pollution;

- Social and economic value of water;
- Value of wastewater;
- Significance of clean water in terms of public health; and
- The cost of not having water.

Therefore, the principle of *there is not enough water* should encompass an understanding of the various values of water and not be limited to the fact that there is not enough water.

Institutions responsible for managing water must be accountable for water quality:

Accountability is the obligation to demonstrate and take responsibility for performance in light of commitments and expected outcomes. In the case of water quality, under our current framework, accountability is not clear because of the complex institutional framework and the current understanding of co-operative governance (Box 3). Accountability implies that someone is accountable to someone else, for something. It is therefore important to ensure that responsibilities are clearly defined, and that those to whom institutions are accountable, clearly understand the standards at which water must be managed, in order that they can assess whether institutions are fulfilling their obligations with regard to water quality. Finally, commitment to management practises that will ensure good quality water must be evident at all levels both within and across the spectrum of water management institutions.

Water quantity and water quality are inextricably linked

It is important to ensure that the above statement is consistently recognized in all aspects of water management.

Poor quality water will reduce the quantity of water available for use and less water will increase the impact of contaminants in water.

The Polluter Pays Principle must be applied to the true cost of water pollution

The Polluter Pays Principle is a well-known and widely accepted environmental policy principle which is applied internationally through various mechanisms. It does, however, raise the question: "pays what?" In the case of water pollution, there are always "downstream costs" of a pollution incident. The term "downstream costs" must be understood in both its literal and figurative sense. There may be costs to water users physically downstream of a pollution incident and there may be significant costs over time owing to environmental deterioration at the site and physically downstream of an incident. Furthermore, "downstream costs" could refer to indirect costs such as the cost of a community not being able to develop as a result of a lack of availability of clean water. It is important therefore, that the polluter pays principle encompasses the expanded definition of "pays what?"

Short-term economic gain at the cost of increasingly deteriorating water quality is not acceptable

This principle refers mainly to the fees levied on dischargers of wastewater to sewer, the discharge which then has an impact on the wastewater treatment works and its capacity to operate optimally.

It is not acceptable that the discharger simply pays increasing fees when the "downstream" cost of discharging is creating a serious long-term impact on the water resource. The short-term economic gain received by those levying charges must be balanced against the total cost of wastewater entering the resource. This principle is closely related to the appropriate valuing of water.

Everyone should have access to water quality information that may not necessarily be in the form of technical data.

Everyone who uses water has some responsibility for water quality. Because water quality is a largely technical issue, most of the "information" disseminated about it, is technical. While this is

necessary at certain levels of responsibility, new and innovative ways to package information about water quality need to be found.

It is important that there is some understanding about water quality at all levels. This will require a "rolling-up" of water quality data into more broadly understood formats.

2.2 Background conditions

Background conditions are defined as those conditions external to water quality which support the implementation of the framework and therefore indirectly impact on water quality and include:

- The value of water (including wastewater) incorporating issues such as cost-benefit incentives and recycling initiatives;
- Management systems and tools (applicable to the various "levels") such as River Health Programmes and other existing water management systems or Water Safety Plans;
- Communication between management units as described in the section to follow and also public access to information (which includes thinking about how to package water quality information for public consumption);
- Accountability including aspects such as the implementation of the polluter pays principle, enforcement mechanisms and the implementation of a government watchdog; and
- Improving institutional capacity.
- Education across the board on water issues, using the Water Use Cycle as the basis for education and awareness;
- Effective strategic planning at various levels which is an acknowledged challenge in most developing countries;
- Funding which is seen as an important supporting condition for integrated water quality management.

Two additional conditions that would have an impact on integrated water quality management but do not fit into the eight main categories mentioned above are:

- Understanding the final Catchment Management structure within the current 19 Water Management Areas in South Africa and how it relates to roles and responsibilities; and
- Research which would include research into alternative and appropriate technologies as well as re-assessment of certain established parameters such as Resource Water Quality Objectives (RWQOs) which may not apply to the whole catchment.

2.3 The management framework

A management unit in the context of the IWQM model is a geographical area; not necessarily homogeneous or continuous; that could be managed as a unit owing to common water use characteristics at the "lower" levels and to institutional responsibilities with regard to the management of water quality at the "higher" levels. Many of the management units identified align with existing established institutions such as municipalities, catchment management agencies or water user associations. However it is important to note that the establishment of a management unit at whatever scale, is not dependent on whether a legislatively established institution exists at that level.

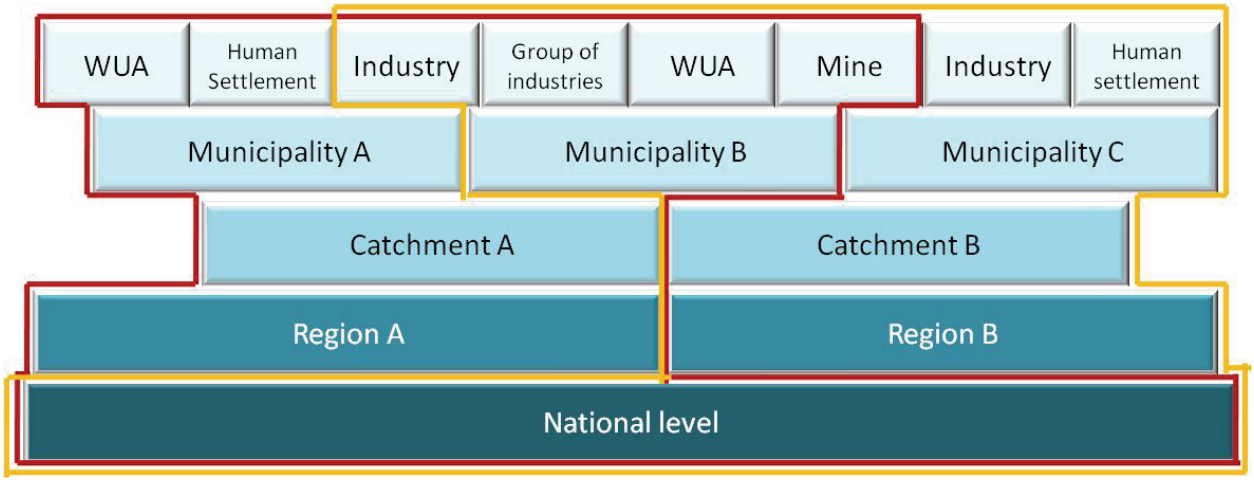


Figure 2: The IWQM Management framework (Boyd, Tompkins and Heath, 2010)

There are four management "levels", which would correspond to management unit types indicated in *Figure 2*.

Community

Note that the word community is used here in the sense of a group of people or organizations with common interests regarding the quality and quantity of the water within their geographical area. Community-type management could be anything from a single factory to a small settlement (informal or otherwise) to a large group of farmers who participate in an irrigation scheme[2].

Municipality

Municipalities with the status of a Water Services Authority (WSA) have the responsibility of ensuring the delivery of water supply to people in their area of jurisdiction and many are also responsible for the treatment and discharge of wastewater.

Catchment

South Africa is currently divided into 19 Water Management Areas (WMAs) which are comprised of one or more catchments (some have as high as eight catchments). Under the National Water Act (1998) (NWA), these areas are administered by Catchment Management Agencies (CMAs) or the DWA if a CMA has not yet been established. The CMA has institutional responsibility for managing water quality in the catchment(s) through the implementation of Resource Water Quality Objectives (RWQOs) which should be identified for all the water resources in their area. However, the process of establishing all RWQOs is a long one, and implementation has been slow. A CMA or even a group of water users at catchment level, which becomes a management unit in this model, can therefore begin the process of managing water quality even if the legislative process is incomplete. The management unit can apply to one catchment or to a group of catchments as delineated by the WMA boundary.

[2] A group such as this is referred to as a Water User Association (WUA) and this is a statutory body established under the South African National Water Act (NWA) No. 36 of 1998 and must be established by a proposal to the Minister of Water Affairs. This means that there are specific provisions regarding what a WUA must undertake to put in place when they are established and also what must be reported on. However, the model presented does not require a group of farmers to be organized in an institution such as a WUA.

Regional/National

This level refers to the regional (or provincial) boundary (which does not always conform to the catchment boundaries) and the national boundary. Here there is definite institutional responsibility under both the NWA (1998) and the Water Services Act (1997) and at this level of the model the background conditions become increasingly important.

The management framework indicated in Figure 1 shows how the various management units (made up of water users or water user groups) relate to each other. This structure also addresses those instances where management units may occur across municipal or catchment boundaries. Figure 1 indicates how the water user groups (management units) are represented in the integrated management context and indicates the overlapping management "chains" from the smallest management unit to the largest at a national level. A single full IWQM management chain is highlighted by the red or yellow line.

The basic premise of the management framework is to break down the challenge of IWQM into manageable areas in order to reduce the reporting between management units to a simple "Yes" (quality and quantity parameters are being met) or "No" (they are not). This approach demands effective auditing but is structured in such a way that adjacent management units audit each other. That is, the management unit is responsible for auditing the quality and quantity, as required, of water entering its geographical area and then reporting on that to the next level of management; as well as to the adjacent upstream management unit, from where the water originated.

It's at this point that the "how" becomes the focus of the model, through a simple generic business process which can be applied at every level of the model.

2.4 The generic business process

The ultimate goal of IWQM is to achieve specific objectives at a particular management unit, taking into consideration the defining principles and background conditions relevant to that management unit. How this is done may be through various tools that may include for example, a Water Safety Plan (WHO, 2005) for a municipality or an integrated water and waste management plan (IWWMP) for an industry (DWAF, 2008). The IWQM business process (*Figure 3*) is generic in the sense that its various elements are applicable to every management unit, and therefore each aspect of the business process must be in place in every management unit. However, the detail of each element will vary according to the type of management unit.

Firstly, it is important to establish a management mechanism which must contain the specific element of:

- Hazard assessment/risk analysis;
- Risk management; and
- Contingency planning.

The implications of implementing the IWQM business process within the various management units would entail the answering of the following five questions (Table 1) in relation to the generic business process described above, and once the hazard/risk assessment has been undertaken, which would mean that the CCPs have been identified.

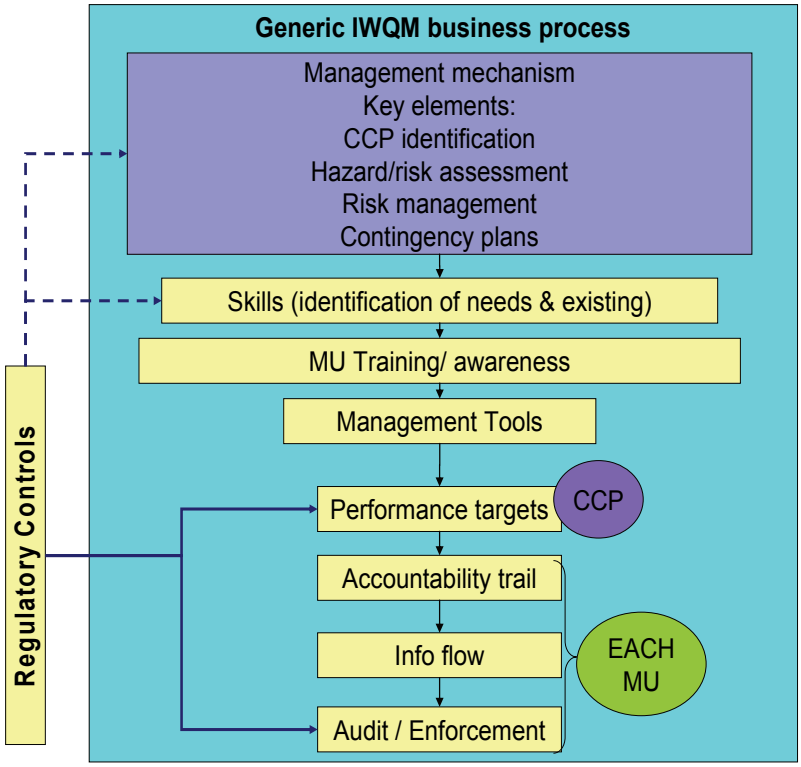


Figure 3: The generic business process (Boyd, Tompkins and Heath, 2010)

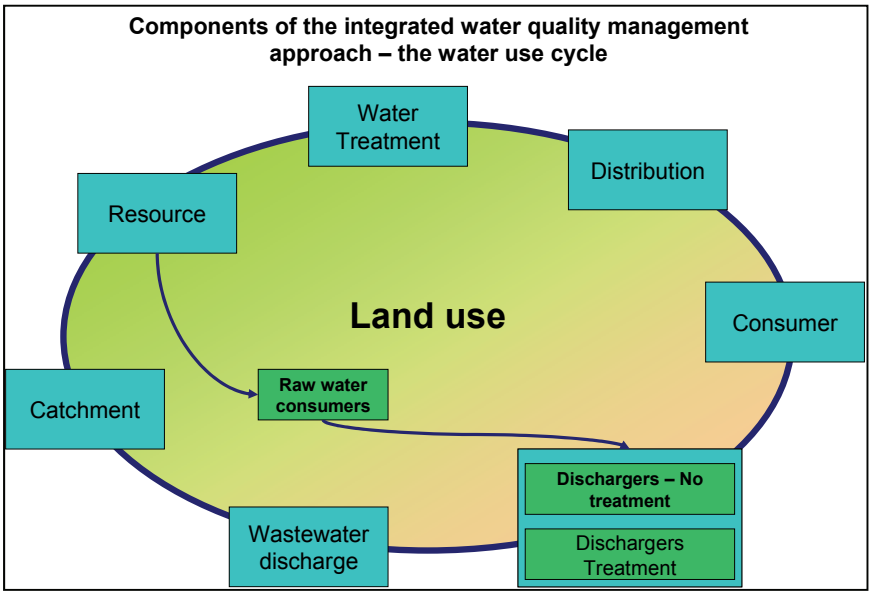
Table 1: Generic business process questions

	Question	Notes
1	What do you (the Management Unit) need to know?	• Information/data flow from the adjacent management units, or smaller units within your MU; and • Information/data requirements at each CCP: – performance targets; – management tools; – reporting requirements; – audit requirements; – regulatory requirements; and – contingency plans.
2	Who needs to tell you and what?	• Information flow; • Organizations within the MUs; • Information/data format ; and • Regulatory framework.
3	Who and what do you need do you need to tell?	• Information flow from you (the MU) to the adjacent or internal MUs; • Information content; and • Information format.
4	What do we need to achieve this?	• Management tools (existing/new); • Relevant posts (existing/new); • Skills (existing/new); and • Training/awareness programmes.

3.0 REFINEMENT OF THE MODEL

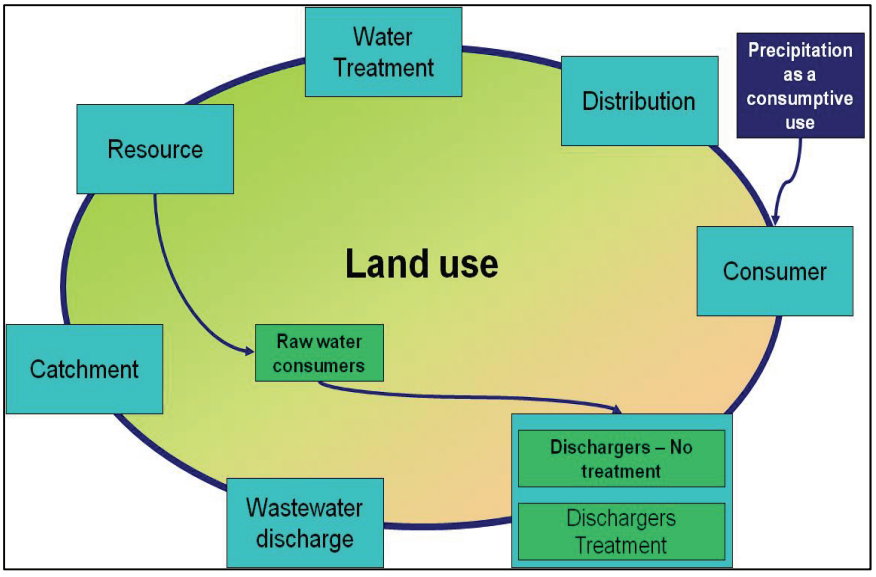
Before discussing the implementation framework and describing the various levels at which the model is being tested it is important to note that certain changes have been made to the original framework. These changes stem from the implementation initiation as well as from discussions at World Water Week and are briefly introduced in the section to follow.

Amendments to the water use cycle



The Water Use Cycle (*Figure 4*) includes the impact of land use as a context to the cycle; and also takes into account the activities of raw water consumers – both raw water abstraction and discharge without treatment, such as may occur from informal settlement.

Figure 4: Water use cycle



The water use cycle continues to evolve and it has been recognized that precipitation as a consumptive use should also be taken into account. This is especially important in rural areas where rainwater is collected, stored and used. The water use cycle depicted in Figure 5 is therefore the context for the IWQM framework in the sense that these are the elements of water use that need to be managed.

Figure 5: Amended water use cycle

Amendments to critical control point description

The initial model describes the process in which the hazard and risk assessment will determine critical controls points (CCPs) which are central to the implementation of the business process in every management unit established. However, during the site visits and the one-on-one meeting's it was agreed that the critical control points could be at various levels of priority. In this respect the

concept of critical risk factors (CRF) has been brought in and the business process changed accordingly (*Figure 6*).

Definitions

Critical Control Point (CCP)

A Critical Control Point (CCP) is defined as a point or process that requires technical target measures or parameter ranges to be met in order to continually assess the hazard potential of the water resource. The CCP is most often defined by regulatory controls.

Critical Risk Factor (CRF)

A CRF is defined as a point or process at which, if a failure occurs, the CCP performance targets will not be met.

Where, a ***point*** includes a discharge point; point in a storm water system; or a point in a water resource[3]; and ***process*** may be a procedure or practice such as optimal fertilizer application rate; dam water levels measured or buffer strips in place; and ***hazard potential*** is defined as the susceptibility of the water resource[1].

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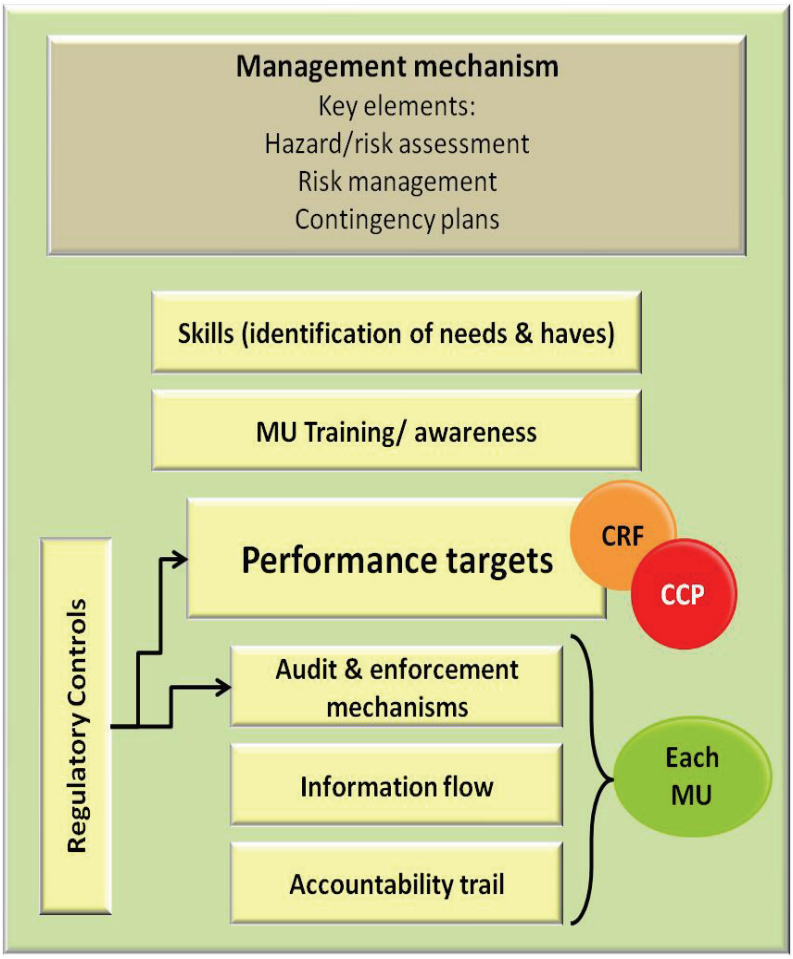


Figure 6: Amended Business Process

In this respect meeting the targets of a CRF can be mitigation for the CCP. Based on the above amendments, the refined conceptual model is illustrated in *Figure 7*.

[3] As defined in the NWA a water resource includes a watercourse, surface water, estuary, or aquifer; and ``watercourse'' means -

(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette,* declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;

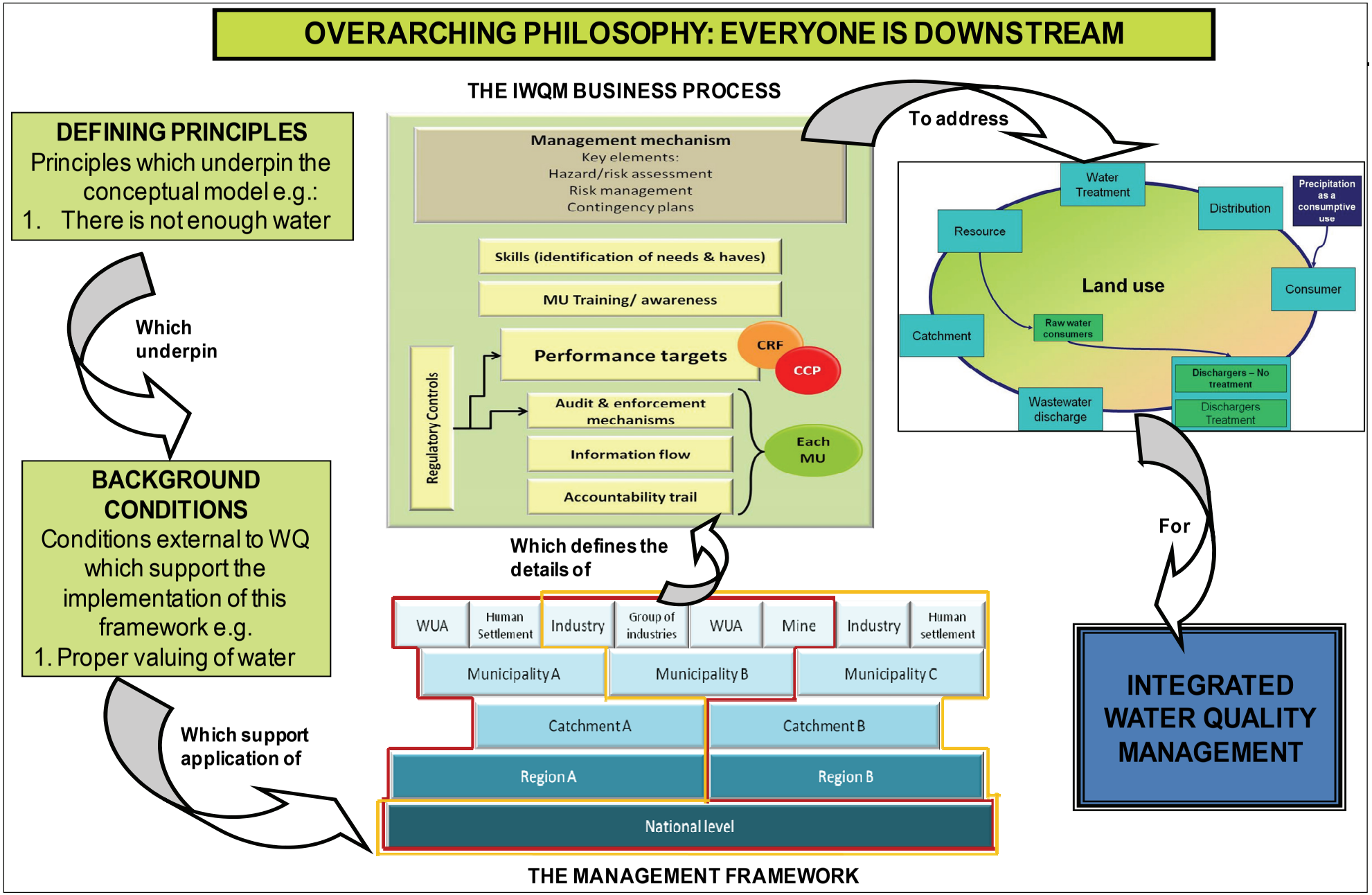


Figure 7: Refined water quality management conceptual model

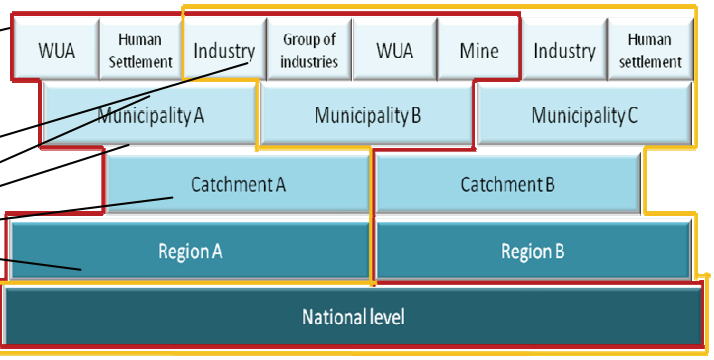
4.0 IMPLEMENTATION FRAMEWORK

This implementation framework sets out a step-by-step process for the implementation of the IWQM model. Each step of the process is described; and the requirements for materials, capacity and equipment identified. Necessary outcomes of each aspect of the process are also identified. It should be made clear that the objective of this section is to provide implementers with a blueprint for implementation of the model in their area, not to populate the model itself.

IWQM MODEL IMPLEMENTATION FRAMEWORK

Step 1: Establish the "outer boundary"

Step 2: Identify potential management units at the various levels



Step 3: "Sign up" management units and establish *accountability*

MU Name				
MU Type	E.g. Community, Water Service Authority, Industrial area, Catchment Management Agency			
Management mechanism	***If there is an existing management mechanism (e.g. WaSP, EMS or CMS), please indicate:***			
	Management Mechanism/(s)			
CCPs / CRFs	**Refer to Table 6**			
Existing management tools	***Indicate whether any tools are currently being used to manage water quality, and if yes, what tools:***			
	Management Tool/(s)			
Regulatory Controls	***Indicate whether any tools are currently being used to manage water quality, and if yes, what tools:***			
	Regulatory Control/(s)			
Available skills:	***Give details of the people involved currently in management of water quality (of factors which may impact water quality)***			
	Personnel Name	***Position***	***Skill***	***Responsible for***
Training requirements:	***Identify where training is necessary to improve achievement of management objectives***			
	Training Type		Objective of training	
Reporting framework	***Give details of other organizations you report to and on what basis:***			
	Report name			
	Date of last report			
	Period (e.g. monthly)			
	Who is the report for			
	What is reported on			
Audit or Enforcement mechanisms	***Indicate whether your area is audited through any process (e.g. ISO 14001 audits, DWA drinking water quality audit, Blue Drop assessment):***			
	Description		***Frequency***	
Accountable person for the MU	***Name***	***Organisation***	***Contact Details***	
			Email	
			Tel	
	Signature:			

Step 5: Develop reporting lines

Step 4: Identify Critical Risk Factors (CRFs) and Critical Control Points (CCPs) and set performance targets

	Defining Critical Risk Factors and Critical Control Points		
		Critical risk factor/(s)	**Critical control point/(s)**
1	Description: What is it?		
2	Why is it a CRF/CCP? (e.g. a discharge point, or where fertilizer is being used		
3	Where is it? (Coordinate or location description - CCPs MUST have coordinates)		
4	What are its targets?		
5	Is mitigation in place? • If yes, what? • If no. what is being done to improve the situation?		

Establishing the "outer boundary"

As described in section 2.0, the IWQM model applies at a number of different levels and in a number of different contexts. There are a series of overlapping management chains in the management framework (*Figure 2*).

Although ultimately the model can be applied at a national level, practically, the model should be applied at a smaller boundary such as a catchment or a municipality or even at community level, as described in section 2.0. It is this practical "outer boundary" that must be initially defined.

It is also important to note that management units established do not have to cover the entire area, but obviously, the more area that is covered by a management unit accountable for their water use, the more effective implementation and positive impact on water quality will be.

Identifying potential management units

Once the outer boundary of the area is defined, potential water user groups, organizations or institutions which can form management units should be identified. It is important to note that the authority or management mandates for the outer boundary area generally exist at the level of the catchment or the municipality.

As described above there are a number of "levels" of the management framework, the first level being the "community" level. Once again it is important to note that in the context of this framework, community is meant in the sense of a community of water users and not necessarily a community of people.

The outcome of this process should be a list of potential management units and contact details for a person who represents or is responsible for the activities undertaken within the ambit of the management unit.

"Signing up" management units

The IWQM model is based on individuals and organizations or institutions using water, being accountable for how they are using that water. Therefore, once potential management units are identified and contact people are identified, each must be approached to 'sign up' to be a management unit. Agreement to be a management unit in the IWQM model should be secured and the business process form (Table 2) completed.

At this point, appointments should be made with the various representatives that have been elected for the management unit to present the model and to begin identifying activities which could be a risk to water quality and quantity. It is very important to note that the CRFs and CCPs, and the performance targets which will be applied in the model, must be established by the management unit themselves. This will give support to in the ownership of the model by the water users.

WHAT IS MEANT BY "ACCOUNTABILITY"?

It must be noted that, in the context of implementation of the IWQM model, the term 'accountability' means taking responsibility to manage for those targets, mitigate against risks and most importantly report to other management units in the framework when targets are not going to be met because a risk factor has been triggered and the CCP is not likely to meet its requirements. Thus the "accountability" discussed in the context of this model is not legislative accountability where an institution has a mandate to meet certain requirements established by legislation and is therefore subject to the provision in the legislation if requirements are not met. It is, however, voluntary accountability to meet the self-imposed requirements of the performance targets stated in the Business Process form discussed below, and signed off on by an authorised representative of the management unit. This is the critical aspect of the model, in that it confers management responsibility for water use on smaller groups who agree to be accountable for their actions with regard to the use of water.

IN THIS WAY, EVERY WATER USER IS A WATER MANAGER

Approaches need to be tailored to the audience. For example, there is no need to create a presentation to give to a rural community on the IWQM model. Instead, the approach should be based around water use. This is something everyone can identify with, rather than complicating the approach with talk of generic business processes and overarching philosophies.

This outcome of this process would be that management units are signed up as committed to the principles of IWQM and take accountability for achieving the targets set for each CRF or CCP and for reporting on these targets.

The Business Process

The business process has been translated into two forms (Tables 2 and 3 below). The first form relates to the following information that is required:

- Management unit (MU) name;
- Management unit (MU) type;
- Management mechanism;
- Critical control points (CCP) and / Critical risk factors (CRF);
- Existing management tools;
- Regulatory Controls;
- Available skills;
- Training requirements;
- Reporting framework;
- Audit or Enforcement mechanisms; and
- Accountable person for the management unit.

The second form relates to the identification of CCPs and CRFs.

Table 2: Business process form

MU Name					
MU Type	e.g. Community, Water Service Authority, Industrial area, Catchment Management Agency				
Management mechanism	***If there is an existing management mechanism (e.g. WaSP, EMS or CMS), please indicate:***				
	Management Mechanism/(s)				
CCPs / CRFs	*See Table 2 for details*				
Existing management tools	***Indicate whether any tools are currently being used to manage water quality, and if yes, what tools:***				
	Management Tool/(s)				
Regulatory Controls	***Indicate whether any tools are currently being used to manage water quality, and if yes, what tools:***				
	Regulatory Control/(s)				
Available skills:	***Give details of the people involved currently in management of water quality (of factors which may impact water quality)***				
	Personnel Name	***Position***	***Skill***	***Responsible for***	
Training requirements:	***Identify where training is necessary to improve achievement of management objectives***				
	Training Type	***Objective of training***			
Reporting framework	***Give details of other organizations you report to and on what basis:***				
	Report name				
	Date of last report				
	Period (e.g. monthly)				
	Who is the report for				
	What is reported on				
Audit or Enforcement mechanisms	***Indicate whether your area is audited through any process (e.g. ISO 14001 audits, DWA drinking water quality audit, Blue Drop assessment):***				
	Description		***Frequency***		
Accountable person for the MU	***Name***	***Organization***	***Contact Details***		
			Email		
			Tel		
	Signature:				

Identifying Critical Risk Factors (CRFs) and Critical Control Points (CCPs)

Section 3.0 set out definitions for critical risk factors (CRFs) and critical control points (CCPs). Based on these definitions, it is clear that the CRFs and CCPs depend largely on the various ways that water is used in the context of the water use cycle (

Figure 4which forms the basic context for which the business process (the “meat” of the IWQM model) has been developed,

So, for example, if the use of water is “Dischargers – Treatment”, the CRFs and CCPs are based around the risks to water quality, and quantity in certain catchments, that this particular use of water will generate.

CRFs and CCPs can therefore not be established without an examination of the uses of water in each management unit. Of course, once the CCPs have been determined, it is important to set targets for them, so that it is clear as to how the risks should be managed.

To manage risk, performance targets are essential. Thus for each CRF and CCP, the management unit must establish performance targets.

In many cases, the performance targets are set by national or local legislation such as municipal bylaws. For example, in the case of a management unit abstracting water to be treated, distributed and provided to consumers, there are likely to be drinking water quality standards required by national legislation, or aligned with international standards under national policy. Often, the performance targets will be set by licenses or permits – for example, for wastewater discharge. In these cases, performance targets do not need to be established. However, where there are no regulatory controls, or quality standards, performance targets must be set.

Table 3 shows the form that would be completed when identifying CRFs and CCPs their relevant performance targets and details regarding how risks will be managed and mitigated. Table 4 shows some examples of CRF and CCPs at various management levels.

Table 3: Description of CCPs and CRFs

	Defining Critical Risk Factors and Critical Control Points	**Critical risk factor/(s)**	**Critical control point/(s)**
1	Description: What is it?		
2	Why is it a CRF/CCP? (e.g. a discharge point, or where fertilizer is being used		
3	Where is it? (Coordinate or location description – CCPs MUST have coordinates)		
4	What are its targets?		
5	Is mitigation in place? • If yes, what? • If no. what is being done to improve the situation?		

Table 4: Example CRFs and CCPs for four management unit levels

	Critical Risk Factors (CRF)				Critical Control Points (CCP)			
	CRF1	**CRF2**	**CRF3**	**CRF4**	**CCP1**	**CCP2**	**CCP3**	**CCP4**
Management Unit	**Chicken farms**	**WUA (irrigation scheme)**	**Municipal area: Sewage works**	**CMA**	**Chicken farms**	**WUA (irrigation scheme)**	**Municipal area: Sewage works**	**CMA**
Description: What is it?	Chicken houses	Addition of fertilizer	Maturation ponds	River down-stream of the irrigation farms	Ground-water (borehole)	River down-stream of the irrigation farms	Up and down-stream of the sewage works	Surface water point in the River
Why is it a CRF/ CCP?	Potential ground-water pollution from wash-down water	Diffuse pollution from run-off from areas where excess fertilizer is added	Overflow from the maturation ponds will contribute to pollution load in the River	Surface water from the River is abstracted for other down-stream uses	Ground-water is used by other domestic water users in the area	Surface water from the River is abstracted for other down-stream uses	Surface water from the River is abstracted for other down-stream uses	Surface water from the River is abstracted for other down-stream uses;
Where is it?	Chicken houses: 33º37'36"S 19º29'34"E	All farms in the Water User Association area	Maturation ponds: 33º28'39.21"S 19º39'03.12"E	*Upstream 1:* 33º24'45"S 19º45'33"E *Down-stream 1:* 33º32'48"S 19º31'42"E	Borehole at: 33º37'34"S 19º29'34"E	*Upstream 1:* 33º24'45"S 19º45'33"E *Down-stream:* 33º32'48"S 19º31'42"E	*Upstream:* 33º28'31"S 19º39'09"E *Down-stream:* 33º28'38"S 19º38'55"E	Down-stream in the River at the border of the two adjacent catchments
What are its targets?	Dry sweeping for removal of solids before wash down	Optimal volume of fertilizer added per hectare	No overflow of ponds	Resource Water Quality Objectives for the River	SANS 241 standards for drinking water	Resource Water Quality Objectives for the River	Resource Water Quality Objectives for the River	Resource Water Quality Objectives for the River
What mitigation is in place?	None; plan to install collection sump to collect polluted water for disposal/ treatment	None; Fertilizer use will be measured and added at optimal concentra-tions	Ponds design; evapora-tion; and irrigation	Monthly monitoring	Quarterly monitoring	Monthly monitoring	Monthly monitoring	Monthly monitoring

Reporting in the IWQM model

The business process form shown in Table 1 indicates a section on reporting. As discussed above, accountability does not exist with both performance targets, and a reporting framework and thus it is essential that each management unit is very clear on the reporting requirements they are responsible for if they sign up as a management unit.

The important issues as regards reporting in the IWQM model are:

- CRFs are reported on internally in the management unit;
- CCPs are reported on externally to other management units in the model;
- Reports are important to track the progress in risk mitigation; and
- It is imperative that downstream users are kept informed if the management unit isn't going to meet its targets.

It's also important to know who the reports are sent to and when? This is noted in the business process form, as indicated in Table 5 because the management unit needs to indicate, for its own purposes, the basis for the reports that they will produce – what, who, how often and when. It is only the reporting framework that is listed in the BP form, but if the management unit has access to MS Excel, a hyperlink to the actual reports can eventually be created. However, it is not necessary to do this until there is enough data that warrants this kind of processing.

Table 5: Details of the management unit's reporting framework

Reporting framework	*Give details of other organizations you report to and on what basis:*				
	Report name				
	Date of last report				
	Period (e.g. monthly)				
	Who is the report for				
	What is reported on				

Managing the data

This IWQM model is a very new mechanism that supports IWRM and systems have not yet been developed to manage the volume of data that will eventually be produced. However a simple excel based spreadsheet has been used in the test case presented in Section 5, that allows for:

- Tracking progress in risk mitigation and risk management;
- Identification of management units that consistently do not meet targets;
- Development of support plans to assist management units which are struggling to improve;
- Assessment of the training and capacity developments required; and
- Monitoring of water and wastewater quality and quantity where applicable.

5.0 TEST CASE IMPLEMENTATION

The model was tested and refined in the Upper Breede Catchment located in the Western Cape Province of South Africa (Figure 8). This catchment falls within the Breede Water Management Area (WMA) and the Breede River Local Municipality.

Figure 8 shows the skewed overlap of the Upper Breede River catchment, which has the mandate to deal with raw water issues, and the Breede River Local Municipality which is responsible for water services provision. The Hex River WUA and the chicken farms are then management units within these higher level management units.

The main water users in the catchment are:

- table grape farms;
- vineyards;
- urban use, including informal settlements and domestic wastewater treatment works;
- various other industries such as pet food producers and distilleries; and
- chicken industry and at least one piggery.

The issues of concern for these water users are therefore related to both quantity and quality, including:

- abstraction of water for irrigation thus reducing the volume of water for downstream users;
- diffuse pollution from agriculture and industries;
- diffuse pollution from urban formal and informal areas; and
- point discharges from industries and sewage works.

Four management units at three levels were then chosen to test the model. These were:

- Breede-Overberg Catchment Management Agency (BOCMA);
- Hex Valley Water User association (HVWUA);
- The Breede Valley Local Municipality; and
- Rainbow Chickens (a plant in Worcester and farm just outside the town).

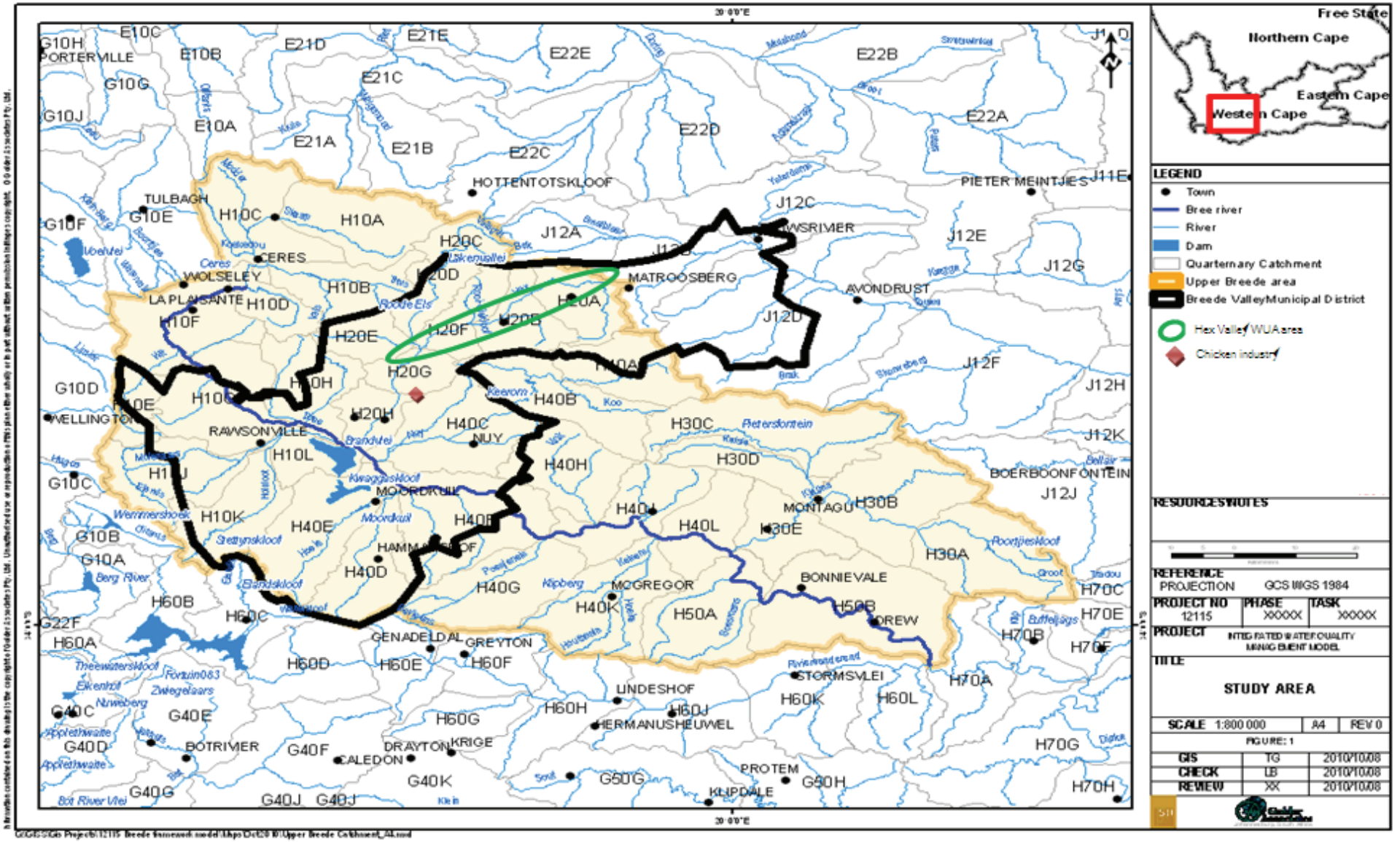


Figure 8: Study area showing management unit overlap

The management framework for the test area is illustrated in *Figure 9*.

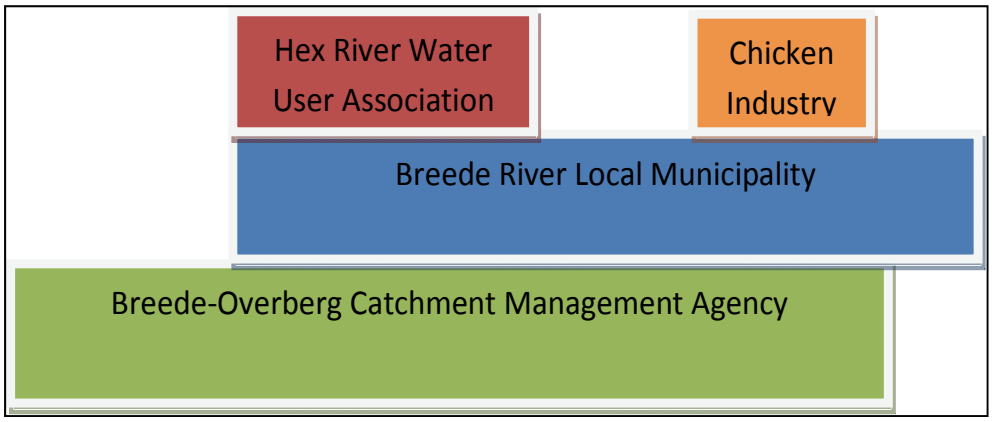


Figure 9: Management framework for the test area

5.1 The business process implemented

The forms presented above in Tables 1 and 2 were used to implement the business process in the study area. An Excel spreadsheet was used to capture the business process form as well as the critical control factor/critical control points form. These are included in electronic format as part of this document. Appendix A sets out the data captured in the business process forms for each of the four management units.

The ***management unit type*** is selected from the list below:

- Community;
- Community Improvement District;
- District Council;
- Industrial Development Zone;
- Industry;
- Municipality;
- Water Management Area (group of catchments);
- Water Service Authority;
- Water Service Provider;
- Water User Association; or
- Other (describe).

If there is an existing ***management mechanism*** such as a Water Safety Plan, Environmental Management Strategy, Catchment Management Strategy or ISO system then this was referenced. If possible such a document should be available as part of a 'pack' that supports the implementation of the model in a specific management unit.

As part of the business process ***tools*** being used to manage water quality and quantity were identified and listed. This will give an idea of where gaps exist and what would still need to be developed for improved water quality and quantity management. Tools identified as part of this exercise were the draft Catchment Management Strategy and monitoring programme for BOCMA; the flow agreement with Worcester East WUA; Service Letters confirming water supply and a telemetric system/flow measurement system for the irrigation dam for the HVWUA; and the environmental management report for Rainbow chickens.

The ***regulatory controls*** relevant to the management unit were identified and included national, provincial and local legislation. For the management units in the study the following regulatory tools are relevant:

- National Water Act (Act 36 of 1998); Chapter 7;
- Catchment Management Plan;
- National Water Act (Act 36 of 1998); Chapter 8;
- Legal agreement (flow agreement) with Worcester East WUA;
- Service Letters confirming water supply;
- Water Services Act (Act 107 of 1997);
- Water Use Authorizations for the Sewage works;
- International Poultry Standards(WHO, 2007);
- Regulations Governing Microbiological Standards (GN 490, Act 54 of 1972);
- SAPA Code of Practice (South African Poultry Association, 2005) ;and
- Municipal by-laws.

In this way awareness is created at the different levels of exactly what regulations are relevant to each management unit.

Water management requires various levels of ***skills***, from samplers to scientists and engineers. In order to get an understanding of what personnel is available, and the skills levels of the personnel, it is important to do a skills audit within each management unit. This will also inform the ***training requirements.***

The ***reporting framework*** described earlier in Table 5 refers only to the reports on the CRFs and CCPs related to this management model, and as described earlier is a vertical and horizontal framework indicated by the arrows in *Figure 10*. It should also be noted, that should it be more relevant for one level to report to a higher level, then that can be included, such as is the case here where the Hex Valley WUA will report to the Breede River Local Municipality, but also on certain CCPs to BOCMA.

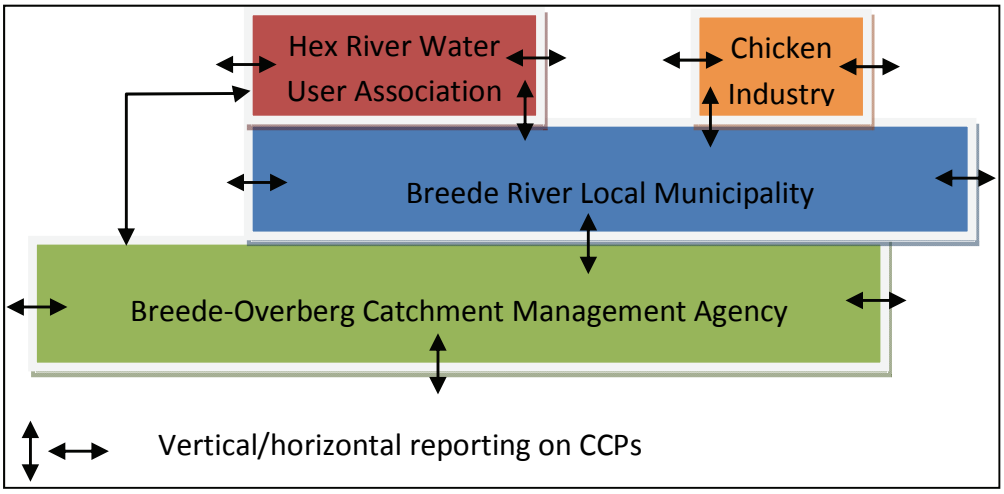


Figure 10: Reporting structure

The ***audit or enforcement mechanisms*** identified as part of the study were;

- ISO14000, environmental management standards;
- District Municipality Sampling;
- Combined BOCMA/Breede Valley Local Municipality monitoring programme:
- Flow monitoring by Worcester East/De Doorns WUAs; and
- National Government auditing processes such as audits on conditions set in water use authorizations.

At this stage it was also important to identify a person within each management unit who would be the champion for the ongoing implementation of the model. It is important to note that while the form allows for the name of a person, the actual position may be more relevant in that people can move frequently, but a position remains fairly constant.

In assessing the ***critical risk factors*** and ***critical control points*** at the various levels the risk assessment procedure described in Chapter 3, section 3.2 of Report TT 450/10 (Boyd, Tompkins and Heath, 2010) was applied.

As part of this study, in assessing the critical risk factors it is important to note that in certain cases a critical risk factor at one level was identified as being a critical control point at another level. An example of how this scenario may come about is described and illustrated below.

Example

Considering a municipal sewage works that discharges to a river within quaternary Catchment X (*Figure 12*).

1. Catchment X would have CCPs at up and downstream points in the catchment.
2. The municipal sewage works discharge point (arrow on figure), as well as points up and downstream in the river to assess the impacts of the discharge, would be CCPs for the municipality.
3. However the up and downstream points may also need to be monitored by the Catchment Management Agency or Department of Water Affairs (CMA/DWA) as part of their mandate to protect the water resources (NWA, 1998).
4. In this respect and considering the definition of a CCP, the municipal CCPs (up and downstream points) would then be CRFs for the CMA/DWA in that, should the municipal in-stream points not meet the targets set, then the non-compliance may cause the CMA/DWA downstream CCP not to be met.

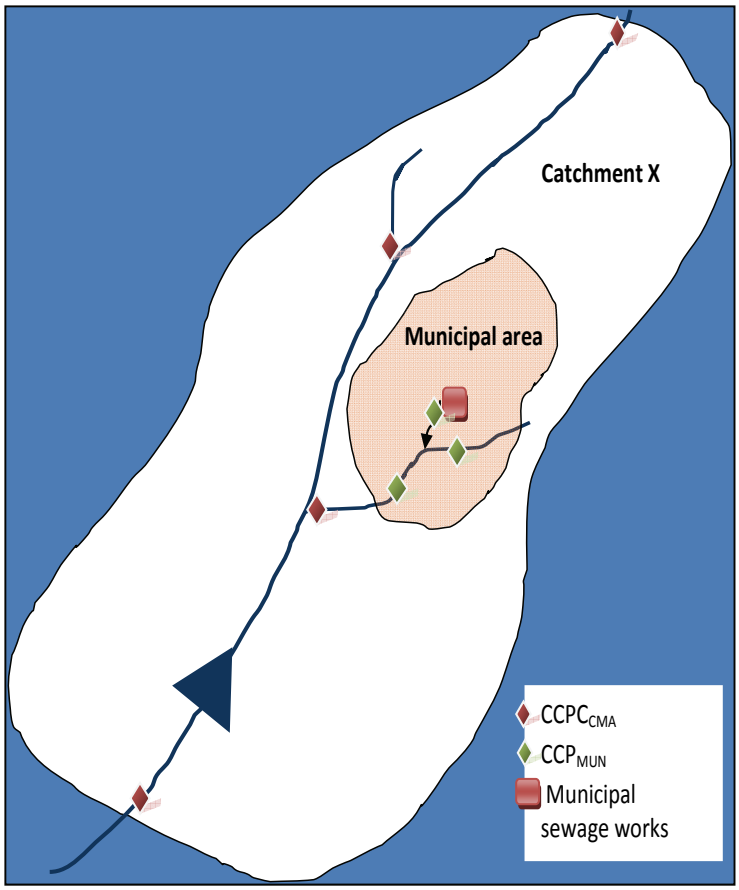


Figure 11: Example Catchment

The critical risk factors and critical control points identified at the various levels are summarized in the section to follow and the detailed tables are included as Appendix B to this report. It is important to remember that a critical risk factor is a point or process at which, if a failure occurs, the CCP performance targets will not be met; in other words meeting the targets set for the critical risk factors means that mitigation is being put in place for the critical control points.

Considering the lowest level management unit included in this study, the chicken farms and plants, the areas of importance when considering water quantity and quality are:

- Truck washing areas;
- Manure and litter areas;
- Slaughtering area;
- Evisceration area;
- Cleansing and disposal area;
- Washing area;
- Treatment plant: and
- Wastewater containment dams.

This can be schematically illustrated (*Figure 12*). The main issues of concern on the farm areas are truck washing and disposal of manure and litter from the chicken houses. These activities may impact on both ground and surface water if not managed and if the targets; such as monitoring the volume of water used for truck washing and disposal of litter and manure from the chicken houses in a designed dedicated area; are met for these CRFs then the likelihood of the CCPs not being met is limited. Remember that a CCP is defined as a hazard and requires technical target measures/parameter range and is usually defined by regulatory controls and will usually be a monitoring point, in the case of the chicken farms, up and downstream points in the surface water resource or the borehole water quality in the area.

CRFs identified in the plant areas are indicated in Figure 12 and if not managed adequately would impact on the municipal sewers and storm water drains which ultimately impact on the surface water resources of the area. In this respect CCP-1RC would be linked to the Municipal CRF, CRF - 4BM. However, had the chicken farms not been a management unit then the drain would have been a CCP at the municipal level. This demonstrates how the reporting would decrease as more management units are included, so that a CCP (external reporting) can become a CRF (internal reporting) at the higher level.

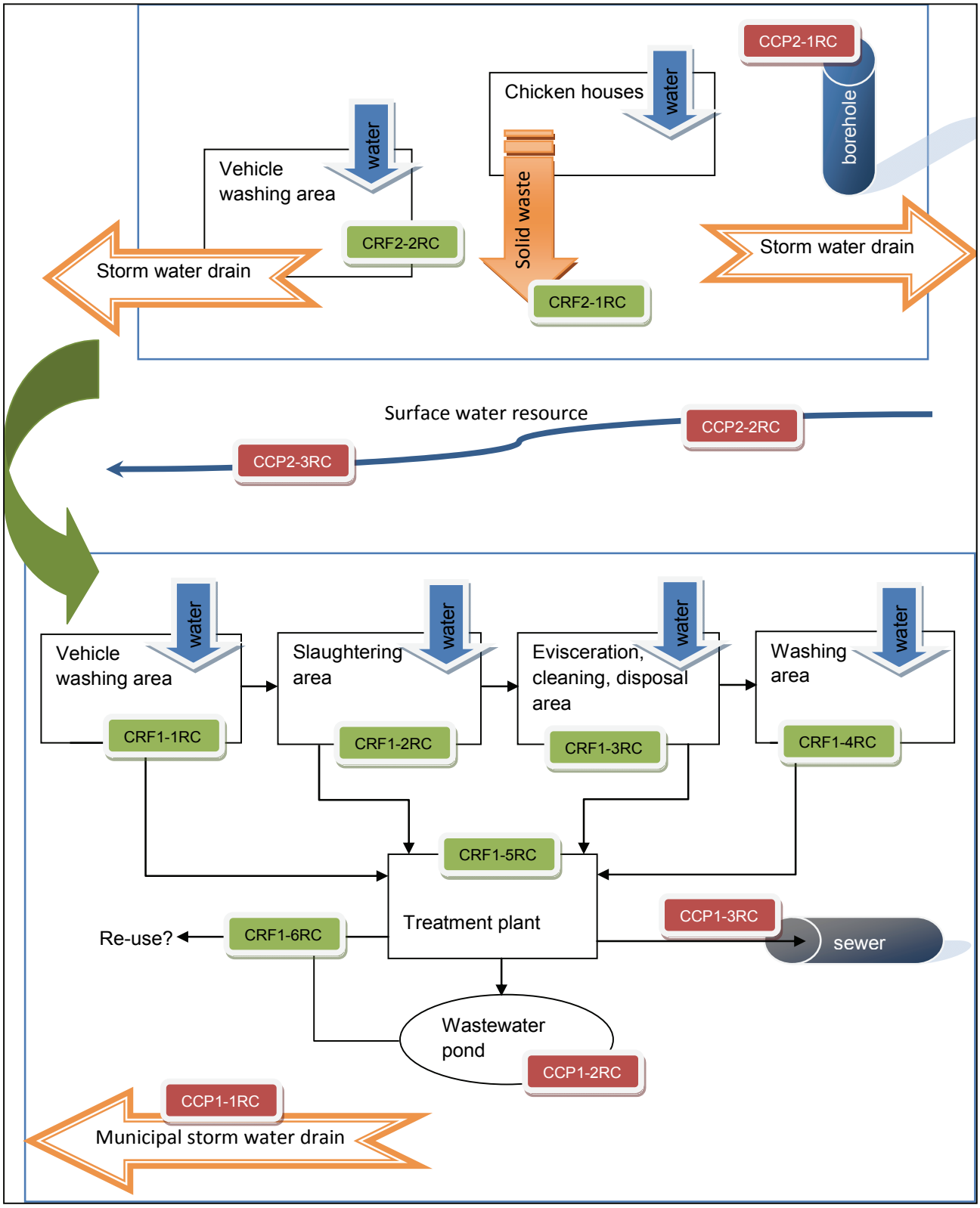


Figure 12: Schematic of the chicken industry processes and potential location of CRFs and CCPs

When considering the Breede River Local Municipality management units there are fewer CRFs compared to CCPs, the reason being that more management units need to be established at the lower level. In this way CCPs at the municipal level, such as storm water drains emanating from for example, industrial areas and informal settlement areas; would become CRFs at the municipal level, as they would be CCPs at the lower level.

In thus study however the following main areas were identified as CRFs and CCPs.

- Municipal sewage works;
- Solid waste landfill site; and
- Storm water drains from:
  - industrial areas; and
  - dense settlement area.

The Hex Valley Water User Association is also a management level below that of the municipal level (*Figure 9*), however, there may be other management units established, such as the pig farm that could then be a level lower. In other words, what this is indicating is that the model is flexible in terms of how management units are established. The CRFs and CCPs for the Hex Valley Water User Association are related to the water quality and quantity needed for irrigation. The pig farm upstream of the irrigation area will therefore have an impact on the quality of the water.

The Breede-Overberg Catchment Management Agency in this study was the highest level management unit and the one CRF for the catchment is related to the CCP in the Hex River (CCP-1H) which forms part of the Hex Valley WUA management unit. The two CCPs relate to up- and downstream points in the catchment. The reporting matrix can then be depicted as indicated in Table 6.

Summary

In summary, considering the test case above which included identification of CRFs and CCPs in various management unit types, it was concluded that the generic business process described in section 2.4 and refined in section 3.0 can be used effectively at various levels of the management framework and across different types of management units in the “community” level of the management framework. The complexity of the process rests in the details rather than the process itself.

This initial implementation has shown that the larger management unit (CMA) has, as expected, fewer CRFs and CCPs than the lower level management units. The number of CRFs is also far higher than the number of CCPs which means that the data to be reported on (only CCP results) would be reduced.

The different types of management units have varying degrees of technical expertise required for measurement of their CCPs.

Table 6: Reporting matrix

Management Unit	Report to:	CCP ID	Compliance (Y/N)		*If no*	Reason	Mitigation	Timeframe
Breede-Overberg CMA (BOCMA)	National Government	CCP-1BO	Yes (all Y)		*If no*	Reason:	Mitigation:	By when:
	HVWUA	CCP-2BO	Yes (all Y)		*If no*	Reason:	Mitigation:	By when:
	Breede Valley Municipality							
Hex Valley WUA (HVWUA)	BOCMA	CCP-1H	Yes (Y to all)		*If no*	Reason:	Mitigation:	By when:
	Breede Valley Municipality	CCP-2H	Y	Y	*If no*	Reason:	Mitigation:	By when:
Breede River Valley Municipality	BOCMA	CCP-1BM	Yes (Y to all)		*If no*	Reason:	Mitigation:	By when:
	HVWUA	CCP-2BM	Yes (Y to all)		*If no*	Reason:	Mitigation:	By when:
	Rainbow chickens	CCP-3BM	Yes/No		*If no*	Reason:	Mitigation:	By when:
		CCP-4BM	Yes (Y to all)		*If no*	Reason:	Mitigation:	By when:
		CCP-5BM	Yes (Y to all)		*If no*	Reason:	Mitigation:	By when:
		CCP-6BM	Yes (Y to all)		*If no*	Reason:	Mitigation:	By when:
		CCP-7BM	Yes (Y to all)		*If no*	Reason:	Mitigation:	By when:
		CCP-8BM	Yes (Y to all)		*If no*	Reason:	Mitigation:	By when:
		CCP-9BM	Yes (Y to all)		*If no*	Reason:	Mitigation:	By when:
Chicken Industry	Breede Valley Municipality	CCP1-1RC	Yes		*If no*	Reason:	Mitigation:	By when:
		CCP1-2RC	Yes		*If no*	Reason:	Mitigation:	By when:
		CCP1-3RC	Yes		*If no*	Reason:	Mitigation:	By when:
		CCP2-1RC	Yes		*If no*	Reason:	Mitigation:	By when:
		CCP2-2RC	Yes		*If no*	Reason:	Mitigation:	By when:
		CCP2-3RC	Yes		*If no*	Reason:	Mitigation:	By when:

6.0 CONCLUSIONS

The IWQM management approach breaks down water management into smaller management units while establishing both a horizontal and vertical reporting framework. A further benefit of the model is that responsibility for water quality is based on significantly smaller geographical areas, and accountability to the adjoining areas (horizontal accountability) and to the next level of management (vertical accountability) is established with the establishment of the management unit. This allows accountability for water quality to be focussed on smaller management units, rather than diffused up ever higher levels of management. In other words, by making all water users aware of their own responsibility to the protection of South Africa's water resources and accountable for the impacts that they have on the resource.

Based on the identification of CRFs and CCPs in various management unit types, it can be concluded that the business process is scalable at the various levels of the management framework and across different types of management units in the "Community" level of the management framework. The complexity of the process rests in the details rather than the process itself, and therefore larger management units would necessarily have more CRFs and (possibly) CCPs and different types of management units would have varying degrees of technical expertise required for measurement of their CCPs.

Finally, the IWQM approach allows water quality information to be packaged for a broader audience, as reporting is simplified to provide information on whether or not a management unit is within specifications of its CCPs; rather than extensive technical reports to national level through the management chain. This addresses the issue of the raising of awareness in the broader community and of the basic premise that good water quality is in everyone's best interests, while providing for everyone's involvement in its management through the allocation of responsibility at more localised levels.

Challenges

Some challenges experienced during the testing of the model are detailed below.

- Establishment of the CMA was very new and several people from both DWA and the municipality had made moves to BOCMA; so that while the passion to implement the project was there, the changes occurring internally hindered the process somewhat as the project team struggled to maintain communication with stakeholders;
- It was recognized that stakeholder management is an unrecognized skill; it needs to be done properly and by a skilled practitioner with experience in those processes, and not as an add-on to the technical team's tasks; and
- When considering the 'bigger picture' of various levels of management units, the question of who will manage the data exists;

Capacity development

As part of the capacity building for the project the following were undertaken:

- Oliver Malete, a project team member, obtained a bursary through Golder Associates Africa and registered and started his Honours degree in Applied Science. This may lead to an MSc in 2011 at the University of Pretoria.
- Dee Padayachee, a project team member, registered with the University of South Africa and started a BSc Honours degree in Environmental Management. Core subjects included impact mitigation, integrated environmental management and environmental systems. The programme runs over two years and is scheduled for completion at the end of 2011.
- Several workshops and working sessions were held with stakeholders from the area.

Conference presentation and proceedings

The project was presented at several conferences and an article accepted for publication in an internal water resources Journal:

- WISA 2010 Durban presentation entitled: Implementation of a conceptual model for integrated water quality management in South Africa, L Boyd, R Tompkins, O Malete and D Padayachee. This paper was presented by O Malete and D Padayachee;
- WISA 2010 workshop: Integrated water quality management: A new mindset, facilitated by R Tompkins and L Boyd;
- Stockholm Water Week (5-11 September 2010) presentation entitled: An integrated water quality management framework for South Africa: A new mindset;
- Boyd L and Tompkins R (2011). A New Mindset for Integrated Water Quality Management for South Africa. International Journal of Water Resources Development, 27: 1, 203-218.
- Presentation at the Young Water Professionals Conference in April 2011 entitled: Implementation of an Integrated Water Quality Management (IWQM) Model – A South African Context. This will be presented by Oliver Malete and Dee Padayachee.

7.0 RECOMMENDATIONS

Based on the results of the second phase, it is recommended that a third phase be undertaken to maintain the momentum of the model implementation. As part of a third phase the following recommendations are made.

Stakeholder engagement

It is recommended that a stakeholder engagement team is added to the project team in order to improve the approach to the implementation of a collaborative management mechanism. The project team should be augmented with specialists in stakeholder participation processes who are directed specifically to that task in order to maintain the links with stakeholders, while the technical team continues its interactive process of workshops to establish Management Units and determine CCPs and CRFs.

Capacity building

To maintain the momentum of the model implementation it is recommended that it is presented more widely at for example, catchment management forum meetings. These meetings are usually constituted of representatives from the various levels that could potentially be management units, including national government.

Web-based system

The implementation of the model will be greatly enhanced if it is converted into a web-based system into which the various management units can report. It is understood that not all management units will have access to the technology required to enter data into such a system and receive reports from it. However, the upper levels of management certainly will. A system for collecting data from those without access to technology (e.g. a management oriented monitoring system or MOMS) should be integrated into the implementation process of the model. Adequate feedback loops must also be created to ensure that reports reach all management units even if they are not operating a web-based system.

8.0 REFERENCES

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World Health Organization (2005) Water Safety Plans, Managing drinking-water quality from catchment-to-consumer WHO/SDE/WSH/05.06

Department of Health. (1997). Regulations Governing Microbiological Standards for Foodstuffs and Related Matters. *Foodstuffs, Cosmetics and Disinfectants Act (Act 54 of 1972)* . South Africa.

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APPENDIX A
Business Process Forms

Business Process Form for the Breede/Overberg Catchment Management Agency (BOCMA)

MU Name	**Breede-Overberg Catchment Management Agency (BOCMA)**					
MU Type	***MU type from list above***	Catchment Management Agency				
Management mechanism	***Management mechanism 1:***	Draft Catchment Management Strategy (1st Draft, December 2010)				
CCPs / CRFs	The Critical Risk Factors and Critical Control Points (CRFs and CCPs) are listed in Appendix B of this report					
Existing management tools	***Management Tool 1:***	Draft Catchment Management Strategy				
	Management Tool 2:	Monitoring Programme				
Regulatory Controls	*Indicate whether any tools are currently being used to manage water quality, and if yes, what tools:*					
	Regulatory Control 1:	National Water Act (Act 36 of 1998); Chapter 7				
	Regulatory Control 2:	Catchment Management Plan				
Available skills	*Give details of the people involved currently in management of water quality (of factors which may impact water quality)*					
	Personnel Name	***Position***	***Skill***	***Responsible for:***		
	Elkerine Rossouw	*Environmental Manager*				
Training requirements:	*Identify where training is necessary to improve achievement of management objectives*					
	Training Type	***Objective of training***				
Reporting: Note that "Reporting" here refers only to the reports on the CRFs and CCPs related to this management model	***Report name***	BOCMA Management Unit Report				
	Date of last report					
	Period (e.g. monthly)	Monthly				
	Who is the report for	National Government; HVWUA; BVLM				
	What is reported on	All BOCMA CCPs				
Audit or Enforcement mechanisms	*Indicate whether your area is audited through any process (e.g. ISO 140001 audits, DWA drinking water quality audit, Blue Drop assessment):*					
	Description		***Frequency***			
Accountable person for the MU	***Name***	***Organization***	***Contact Details***			
	Elkerine Rossouw	**BOCMA**	***Email:***	eroussouw@bocma.co.za		
			Tel:	*082 410 4460*	***Fax:***	
	Signature:					

Business Process Form for the Hex Valley Water User Association (HVWUA)

MU Name	**Breede-Overberg Catchment Management Agency (BOCMA)**			
MU Type	***MU type from list above***	Water User Association		
Management mechanism	***Management mechanism 1:***	Constitution of the Hex Valley WUA		
		Business Plan (Item 21 of NWA) of the Hex Valley WUA		
		Allocation schedule as per Service Letters		
CCPs / CRFs	The Critical Risk Factors and Critical Control Points (CRFs and CCPs) are listed in Appendix B of this report			
Existing management tools	***Management Tool 1:***	Legal agreement (flow agreement) with Worcester East WUA		
	Management Tool 2:	Service Letters confirming water supply		
	Management Tool 3:	Telemetric system / flow measurement system for the Osplaas Dam		
Regulatory Controls	*Indicate whether any tools are currently being used to manage water quality, and if yes, what tools:*			
	Regulatory Control 1:	National Water Act (Act 36 of 1998); Chapter 8		
	Regulatory Control 2:	Legal agreement (flow agreement) with Worcester East WUA		
	Regulatory Control 3:	Service Letters confirming water supply		
Available skills	*Give details of the people involved currently in management of water quality (of factors which may impact water quality)*			
	Personnel Name	***Position***	***Skill***	***Responsible for:***
	Andre Thops	Chairman of Hex Valley WUA	Management & Reporting	Reporting on CRPs & CCPs in this process
Training requirements:	*Identify where training is necessary to improve achievement of management objectives*			
	Training Type	***Objective of training***		
	e.g. Water sampling training	To provide our sampler with the necessary skills to take samples correctly		
Reporting: Note that "Reporting" here refers only to the reports on the CRFs and CCPs related to this management model	***Report name***	HVWUA Management Unit Report		
	Date of last report	-		
	Period (e.g. monthly)	Monthly		
	Who is the report for	Breede Valley WSA; BOCMA; Rainbow Chickens		
	What is reported on	All Hex Valley WUA CCPs		
Audit or	Indicate whether your area is audited through any process (e.g. ISO 140001 audits, DWA drinking water quality audit, Blue Drop assessment):			

Enforcement mechanisms	***Description***		***Frequency***			
	Flow monitoring by Worcester East / De Doorns WUAs					
	District Municipality Sampling					
	BOCMA sampling					
Accountable person for the MU	***Name***	***Organization***	***Contact Details***			
	Andre Thops	**Hex valley WUA**	***Email:***	andrethops@gmail.com		
			Tel:	023 356-3275	***Fax:***	023 356-3552
	Signature:					

Business Process form for the Breede River Local Municipality (BRLM)

MU Name	Breede River Local Municipality			
MU Type	***MU type from list above***	Municipality		
Management mechanism	***Management mechanism 1:***			
CCPs / CRFs	The Critical Risk Factors and Critical Control Points (CRFs and CCPs) are listed in Appendix B of this report			
Existing management tools	***Management Tool 1:***	Monitoring programme		
	Management Tool 2:			
Regulatory Controls	*Indicate whether any tools are currently being used to manage water quality, and if yes, what tools:*			
	Regulatory Control 1:	Water Services Act (Act 107 of 1997)		
	Regulatory Control 2:	Sewage works water use authorizations		
	Regulatory Control 3:	Municipal by-laws		
Available skills	*Give details of the people involved currently in management of water quality (of factors which may impact water quality)*			
	Personnel Name	***Position***	***Skill***	***Responsible for:***
Training requirements:	*Identify where training is necessary to improve achievement of management objectives*			
	Training Type	***Objective of training***		
Reporting framework: Note that "Reporting" here refers only to the reports on the CRFs and CCPs related to this management	***Report name***	BRLM Management Unit Report		
	Date of last report			
	Period (e.g. monthly)	Monthly		
	Who is the report for	BOCMA; HVWUA and Chicken industry		
	What is reported on	All BRLM CCPs		
Audit or Enforcement mechanisms	*Indicate whether your area is audited through any process (e.g. ISO 140001 audits, DWA drinking water quality audit, Blue Drop assessment):*			
	Description		***Frequency***	
Accountable person for the MU	***Name***	***Organization***	***Contact Details***	
			Email:	
			Tel:	***Fax:***
	Signature:			

Business Process form for the Rainbow Chickens processing plant and farms

MU Name	Rainbow Chickens farms and plant			
MU Type	***MU type from list above***	Industry		
Management mechanism	***Management mechanism 1:***	ISO 14001		
	Management mechanism 2:	Water Management Plan		
	Management mechanism 3:	Key Performance Areas		
CCPs / CRFs	The Critical Risk Factors and Critical Control Points (CRFs and CCPs) are listed in Appendix B of this report			
Existing management tools	***Management Tool 1:***	Flow meters		
	Management Tool 2:	Containment Dam Report		
	Management Tool 3:	Environmental Management report		
Regulatory Controls	*Indicate whether any tools are currently being used to manage water quality, and if yes, what tools:*			
	Regulatory Control 1:	International Poultry Standards		
	Regulatory Control 2:	Regulations Governing Microbiological Standards		
	Regulatory Control 3:	SAPA Code of Practice		
	Regulatory Control 4:	Municipal by-laws		
Available skills	*Give details of the people involved currently in management of water quality (of factors which may impact water quality)*			
	Personnel Name	***Position***	***Skill***	***Responsible for:***
	Mia Boonzaier	*SHEQ Coordinator Agric*	*Environmental Management & Reporting*	*Reporting on CRPs & CCPs in this process*
Training requirements:	*Identify where training is necessary to improve achievement of management objectives*			
	Training Type	***Objective of training***		
Reporting framework: Note that "Reporting" here refers only to the reports on the CRFs and CCPs related to this management	***Report name***	Rainbow Chickens Management Unit Report		
	Date of last report			
	Period (e.g. monthly)	Monthly		
	Who is the report for	Breede River Local Municipality		
	What is reported on	All CCPs at Rainbow Chickens		
Audit or Enforcement mechanisms	*Indicate whether your area is audited through any process (e.g. ISO 140001 audits, DWA drinking water quality audit, Blue Drop assessment):*			
	Description		***Frequency***	

Accountable person for the MU	***Name***	***Organization***	***Contact Details***			
			Email:			
			Tel:		***Fax:***	
	Signature:					

APPENDIX B

Critical Risk Factors and Critical Control Points at various Management Levels

Critical risk factors and critical control points for BOCMA

	CRF-1BO: CCP-1H	CCP-1BO	CCP-2BO
Management Unit	**The Breede/ Overberg CMA**	**The Breede/ Overberg CMA**	**The Breede/ Overberg CMA**
Description: What is it?	Hex River downstream of the irrigation farms	Surface water point in the Breede River	Surface water point in the Breede River
Why is it a CRF/CCP?	Surface water from the Hex River is abstracted for other downstream uses	Surface water from the Breede River is abstracted for other downstream uses;	Surface water from the Breede River is abstracted for other downstream uses;
Where is it?	Point in the Hex River as it enters the Breede River 33º32'54.00"S 19º31'34.59"E	Upstream in the catchment 33º25'08.90"S 19º17'11.78"E	Downstream in the catchment 34º04'05.43"S 20º17'11.09"E
What are its targets?	Resource Water Quality Objectives for the Hex River	Resource Water Quality Objectives for the Upper Breede River catchment	Resource Water Quality Objectives for the Upper Breede River catchment
What measures are in place to assess the targets?	Monthly monitoring	Monthly monitoring	Monthly monitoring

CRFs/CCPs for the Hex River Water User Association

	CRF-1H	CRF-2H	CCP-1H	CCP-2H
Management Unit	**Pig farm**	**The Hex River Valley WUA (irrigation scheme)**	**The Hex River Valley WUA (irrigation scheme)**	**The Hex River Valley WUA (irrigation scheme)**
Description: What is it?	Pig farm dams	Addition of fertilizer	Hex River downstream of the irrigation farms	Main irrigation dam
Why is it a CRF/CCP?	Overflow from pig farms will enter and pollute the surface water resource	Diffuse pollution from run-off from areas where excess fertilizer is added	Surface water from the Hex River is abstracted for other downstream uses	Water quantity management
Where is it?	Pig farm dams 33º24'46.39"S 19º45'23.46"E	All farms in the Water User Association area	Point in the Hex River as it enters the Breede River 33º32'54.00"S 19º31'34.59"E	*Irrigation Dam* 33º29'15.15"S 19º38'43.74"E
What are its targets?	No overflow from dams	Optimal volume of fertilizer per hectare added (to be researched)	Resource Water Quality Objectives for the Hex River	Volume of water agreed to in contract
What measures are in place to assess the targets?	Pond level monitoring in place	None; Fertilizer use will be measured and added at optimal concentrations	Monthly monitoring; Management of all HVMU CRFs to performance targets	Monthly monitoring; if in breach of contract, a fine is paid

CRFs and CCPs for the Breede River Local Municipality

	CRF-1BM	CRF-2BM	CRF-3BM: CCP-1H	CRF-4BM: CCP1-1RC	CCP-1BM	CCP-2BM	CCP-3BM	CCP-4BM	CCP-5BM	CCP-6BM	CCP-8BM	CCP-9BM
Management Unit	**The Breede River Municipality: Critical Risk Factors**				**The Breede River Municipality: Critical Control Points**							
Description: What is it?	Oxidation pond system De Doorns (no discharge)	Solid waste landfill site	Irrigation area (Hex River WUA CCP 1H)	Industrial area	Sewage works: Worcester (discharge)			Dense settlement			Solid waste landfill site	
Why is it a CRF/CCP?	Surface water is abstracted for other downstream uses; overflow from the maturation ponds will contribute to pollution load	Surface water is abstracted for other downstream uses; solid waste entering stormwater from windblown waste will contribute to pollution load (aesthetic)	Surface water from the Hex River is abstracted for other downstream uses	Polluted stormwater may enter the surface water and impact on downstream water users	Surface water from the Breede River is abstracted for other downstream uses; poor quality discharge will impact on downstream users			Polluted stormwater and grey water to surface water will impact on downstream water users			Leachate from the landfill site may cause groundwater contamination	
Where is it?	*Oxidation ponds:*	*Landfill site*	*The point in the Hex River as it enters the Breede River*	*Stormwater drain downstream of the industrial area*	*Final Effluent discharge point*	*Upstream in the river:*	*Downstream in the river:*	*Stream 1 leaving the area*	*Stream 2 leaving the area*	*Downstream in the river*	*Borehole upstream of the landfill site*	*Borehole downstream of the landfill site*
	33º28'39.21"S	33º40'54.18"S	33º32'48.19"S	33º38'49.19"S	33º40'06.43"S	33º41'04.53"S	33º41'26.76"S	33º39'16.66"S	33º39'13.72"S	33º39'13.72"S	33º41'01.17"S	33º40'52.87"S
	19º39'03.12"E	19º28'09.27"E	19º31'42.36"E	19º28'12.88"E	19º26'59.91"E	19º25'17.50"E	19º26'02.75"E	19º29'54.14"E	19º29'33.42"E	19º29'33.42"E	19º28'17.31"E	19º27'56.78"E
What are its targets?	No overflow from ponds	No windblown waste	RWQOs for the Hex River	RWQOs for the Upper Breede River	Final effluent WUL targets;	Resource Water Quality Objectives for the Breede River	Resource Water Quality Objectives for the Breede River	RWQOs for the Upper Breede River	RWQOs for the Upper Breede River	RWQOs for the Upper Breede River	Groundwater quality limits	Groundwater quality limits
What measures are in place to assess the targets?	Ponds design; evaporation; and irrigation	Daily monitoring of windblown waste	Monthly water quality monitoring	Monthly water quality monitoring	Monthly water quality monitoring	Monthly water quality monitoring	Monthly water quality monitoring	Monthly water quality monitoring	Monthly water quality monitoring	Monthly water quality monitoring	Quarterly water quality monitoring	Quarterly water quality monitoring
Reporting	Yes	Yes	Yes (Y to all)	Yes/No	Yes (Y to all)	Yes (Y to all)	Yes (Y to all)	Yes (Y to all)	Yes (Y to all)	Yes (Y to all)	Yes (Y to all)	Yes (Y to all)
	If no:	**If no:**	**If no:**	**If no:**	**If no:**	**If no:**	**If no:**	**If no:**	**If no:**	**If no:**	**If no:**	**If no:**
	Reason:	Reason:	Reason:	Reason:	Reason:	Reason:	Reason:	Reason:	Reason:	Reason:	Reason:	Reason:
	Mitigation:	Mitigation:	Mitigation:	Mitigation:	Mitigation:	Mitigation:	Mitigation:	Mitigation:	Mitigation:	Mitigation:	Mitigation:	Mitigation:
	By when:	By when:	By when:	By when:	By when:	By when:	By when:	By when:	By when:	By when:	By when:	By when:

CRFs for Chicken farms processing plant and farms areas

	CRF1-1RC	CRF1-2RC	CRF1-3RC	CRF1-4RC	CRF1-5RC	CRF 1-6RC	CRF2-1RC	CRF2-2RC
Management Unit	**Rainbow Chickens: Processing Plant**						**Rainbow Chickens: farms**	
Description: What is it?	Truck washing area	Slaughtering area	Evisceration, cleansing and disposal area	Washing area	Treatment plant: Influent quality in terms of COD/BOD	Wastewater containment dams	Manure and Litter areas	Truck/car washing area
Why is it a CRF/CCP?	Possible surface water runoff and water ingress	Possible inefficient use of water and generation of blood wastewater	Possible inefficient disposal methods and microbial contamination from spilled guts	The utilization of large volumes of water	Quality will dictate treatment requirements	The quality of this water dictates how much wastewater is reclaimed to acceptable standards for re-use (water re-use optimization)	Potential of non-point source pollution	Possible surface water runoff and water ingress
Location of CRF/CCP	Area outside plant before entry/exit from property	As on plant layout diagram	As on plant layout diagram	As on plant layout diagram	As on plant layout diagram	As on plant layout diagram	Outside areas of the chicken farm at manure dumping and/or processing site	Area outside plant before entry/exit from property
What are its targets?	Adequate truck washing to minimize non-point source pollution: about 0.114m^3/truck	International legislation related EMS targets; volume of water per bird	Use of best industry disposal practices	Volume of water per bird; best wastewater disposal practices.	BOD/COD concentration (by-laws?)	Maintain process water to required quality standard	Operating procedures in terms of best technology options in place	Adequate vehicle washing to minimize non-point source pollution: about 0.114m^3/truck

	CRF1-1RC	CRF1-2RC	CRF1-3RC	CRF1-4RC	CRF1-5RC	CRF 1-6RC	CRF2-1RC	CRF2-2RC
Management Unit	**Rainbow Chickens: Processing Plant**						**Rainbow Chickens: farms**	
Measures in place to assess targets	Visual inspection; to ensure hoses are not left on; monthly water usage measurement	Daily water usage measurement	visual inspection to assess cleanliness and correct disposal	Daily water usage measurement	On-line monitoring of BOD/daily monitoring?	On-line monitoring of BOD/daily monitoring?	Visual inspection to assess disposal in terms of correct operating procedures	Visual inspection; to ensure hoses are not left on; monthly water usage measurement

CCPs for Chicken farms processing plant and farms areas

	CCP1-1RC	CCP1-2RC	CCP1-3RC	CCP2-1RC	CCP2-2RC	CCP2-3RC
Management Unit	**Rainbow chickens: Processing Plant**			**Rainbow Chickens: Farms**		
Description: What is it?	Stormwater drain	Wastewater pond	Treatment Plant: Effluent quality in terms of COD/BOD for sewer discharge	Borehole(s) on site	Nearest stream upstream of chicken farm	Nearest stream downstream of chicken farm
Why is it a CRF/CCP?	Polluted stormwater entering the municipal stormwater system could impact on surface water resources in the area	Overflow from pond could lead to surface water pollution	Impact on the municipal WWTW	Potential groundwater pollution	Potential surface water pollution from contaminated stormwater run-off	Potential surface water pollution from contaminated stormwater run-off
Location of CRF/CCP	Stormwater drain:	Wastewater pond	Discharge point to sewer	Located at particular distances from the main chicken houses.	*Upstream:*	*Downstream:*
What are its targets?	RWQOs for catchment	No overflow from ponds	Municipal targets for discharge to sewer	Groundwater quality limits	RWQOs for surface water resource in question	RWQOs for surface water resource in question
Measures in place to assess targets	Monthly sampling or as required if a spillage occurs	Level monitors to continuously monitor pond levels;	Monthly monitoring (quality and quantity)	Quarterly sampling	Quarterly sampling	Quarterly sampling